March
1955

MECHANICAL ENGINEERING

ASME Diamond Jubilee Spring Meeting ◆ Baltimore, Md. ◆ April 18–21, 1955

Volume 77 ♦ Number 3

MARCH 1955

♦

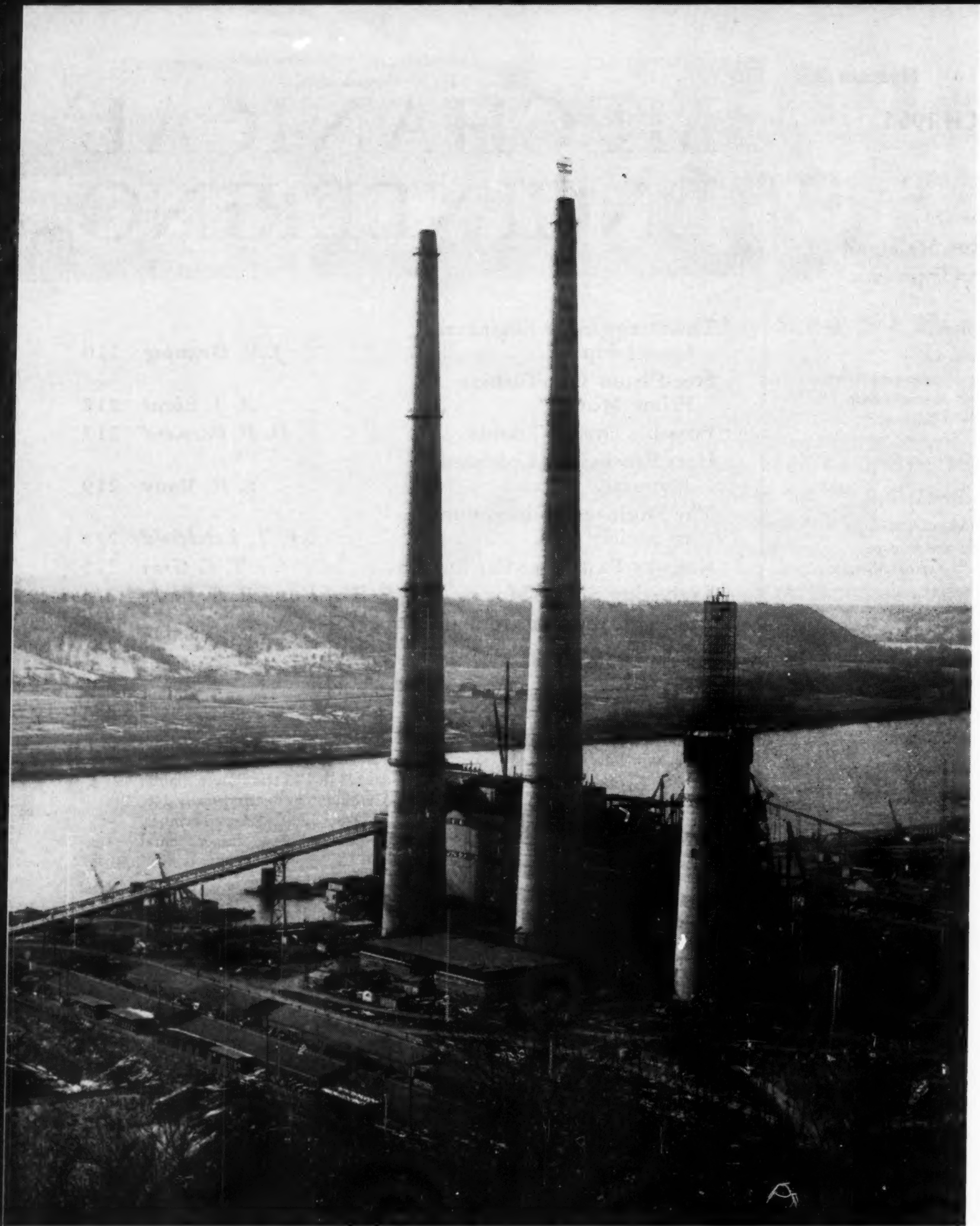
Published by

The American Society of Mechanical Engineers

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price to members and affiliates one year $3.50, single copy 50 cents, to nonmembers one year $7.00, single copy 75 cents. Add $1.50 for postage to all countries outside the United States, Canada, and the Pan-American Union. Changes of address must be received at Society headquarters seven weeks before they are to be effective on the mailing list. Please send old as well as new address.... By-Laws: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4).... Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879.... Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921.... Member of the Audit Bureau of Circulation. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author and that date of publication be stated.

MECHANICAL ENGINEERING is indexed by the Engineering Index, Inc.

MECHANICAL ENGINEERING



Clifty Creek Plant at Madison, Ind. . . .

. . . a 1,200,000-kw electric-generating station, will be the world's largest steam-power plant when completed in 1956. It is one of two major plants being built by the Ohio Valley Electric Corporation to supply electric power to the Atomic Energy Commission's new $1^{1}/_{4}$ billion Portsmouth, Ohio, diffusion plant. See page 245 in this issue.

Editorial

MECHANICAL ENGINEERING

March, 1955, Vol. 77, No. 3 ◆ George A. Stetson, *Editor*

Services of Engineers . . .

What makes an engineering society a vital, influential, effective, and useful institution?

Undoubtedly, as the Founders of The American Society of Mechanical Engineers predicted three quarters of a century ago, a prime factor in the success of the Society is to be found in the high quality of the membership, the dedication to duty of the elected officers who determine its policies and administer its affairs, and the thousands of committeemen who voluntarily devote time, talent, and energy to services for the benefit of their fellow members.

ASME is rich in men of achievement and promise. Recently the number of members has exceeded the forty-thousand mark. Who these men are, what posts they hold, and where they live and work can be found by consulting the 1955 ASME Membership List, issued in February. The list contains the names of men who were undergraduates a year ago. It also contains the names of men who have been members for more than fifty years. The older men helped make ASME what it is today; the younger men will guide it to even greater distinction.

Regardless of his age group, each member plays a dual role. As an individual he must develop his own career and in so doing he is justified in expecting certain benefits and services from his Society. As a member he gives what he can, as the opportunity is offered to him, to the Society and his fellow members. Unless he does so there will be no benefits or services. Hence, thousands of individual members are active as committeemen at the national and local level in any single year. In the current year the names of those serving at the national level will be found in ASME Annual AC-10, "Personnel of Council, Boards, and Committees," issued in March. Others are serving in the Sections and Student Branches, and still others provide technical papers and manpower for meetings and conferences. These services of members constitute the Society's richest resource.

At this time of the year every ASME member has an opportunity to serve his Society by taking part in the discussions going on in his Section of items relating to improvement of Society operations and activities that appear in the first compilation of the 1955 National Agenda. By such service he can help his Society serve him. Items on which 15 Sections vote favorably will be passed on to the Regional Administrative Committee meeting in March, April, and May, and eventually to the Regional Delegates Conference at Boston in June. Recommendations of the Conference will be referred to the Council, and the Council's actions will be reported in Mechanical Engineering as those relating to the 1954 Conference were reported last month (see pages 199–201 of that issue). It is through such a process that the ideas of an individual member may be thoroughly discussed and presented to the Council for action.

. . . to Engineers

Last summer every ASME member was asked to fill out a questionnaire relating to his special interests. By Oct. 1, 1954, 56 per cent of the members had responded and the task of compiling the results was undertaken. The gross figures are now made public (see pages 236–240) so that every member may examine them and draw such conclusions as he believes to be valid and important.

To shed further light on the significance of these over-all statistics, additional tables have been prepared in which the replies to certain questions are related to those of other questions. For example: In one of these tables members' preferences for certain features of Mechanical Engineering are related to their replies to the question, "How well does Mechanical Engineering meet your needs?" Obviously, a proper interpretation of such statistics should aid the Publications Committee in its efforts to improve its service to members. Similarly, other groupings of the statistics should throw light on other Society services.

Helpful as the results of the Survey should be, it must not be concluded that the Society has been marking time while waiting for them. On the contrary, the Society has been operating with vigor and imagination. For example, announcement was made in January of the reorganization of the ASME Council to provide for more directors, an increase in the membership of the Nominating Committee to insure representation of certain groups, and the formation of a Nuclear Engineering Division. More recently the Publications Committee has set up an advisory group to recommend improvements in publications policy and procedures; and the principal committees reporting to the Board on Technology (Meetings, Professional Divisions, Publications, and Research) met in January with representatives of the Professional Divisions at a Technology Executives Conference (see ASME News) where important subjects were discussed.

The Struggle for Engineering Leadership

Is the competition in training scientists and engineers being lost to Iron Curtain countries?

By John R. Dunning

Dean, Columbia University School of Engineering, New York, N. Y. Member ASME

We look out upon a world whose keynote is dynamic change—an increasing rate of dynamic change. We look out on a world which anticipates with grave concern the possibility of a next world war—a war which in the first few hours will take out nearly every major population center and every industrial center—one half of the population of the countries involved.

On the other hand, as a result of the work of the engineers in this increasingly technological civilization, we also face a world, which, at this moment, is just barely beginning to realize the potentialities of what engineering and science can do.

It is time, perhaps, to stop and take stock of ourselves. What is our role in the scheme of things today and what kind of a role do we want to play during the next 25 years, as ASME looks forward to filling out its century?

It is certain that every one of us involved in the application of engineering and science is profoundly and deeply convinced that, properly used, the methods and the tools that we have just begun to develop are infinitely more effective in applications for the good life than in the cause of destruction.

The Engineer's Task

The primary task of the engineer—to put to work discoveries in the field of basic science for the benefit of mankind—is only beginning to be understood by our fellow citizens.

We are faced with drastic competition in this endeavor from behind the Iron Curtain. It is only within recent years that sufficient data have become available to appraise the extent of this competition. Shortly after the revolution 35 years ago, and after driving out many good mechanical engineers—members of this Society such as George Karelitz and Timoshenko—Russian leadership decided to make the development of engineering and science the keynote, the fundamental basis of Russian expansion. The Russians turned the education of the engineers back to the professionals in the universities, while most of us were misled with tales of peasant education, literacy, and like movements.

Russians Closing the Gap

We awoke with a real shock about a year ago, and an even worse shock last June, when we found the Russians were graduating about $2^1/_2$ times as many engineers as were matriculating from our institutions of technology. The situation was unfolded through the various arms of our Intelligence Services, through the professional societies' groups who have been studying the problem, through our own Engineers Joint Council, and the Engineering Manpower Group, the Scientific Manpower Commission, and the National Academy of Science's Research Council. Even now we have only a partial picture.

However, it is clear that not only have the Russians been outproducing us to the point where their total number of engineers is now essentially the same as ours, but on the Master's and Doctoral levels they appear to have been giving degrees to probably three or four times as many as we have. The news is even more disturbing because of the few analyses we have of their professional output. Neither the British nor ourselves today have even a translation service of the Russian professional journals which has been agreed upon properly among our professional engineering and scientific societies. Such translations as have been made, largely for military security purposes, are exceedingly disturbing. From the best analysis we can make, it would appear that in many areas the Soviets are equal to us; sometimes they're a little behind, but all too often they actually seem to be ahead of us.

The same situation may exist as in the case of the development of thermonuclear weapons. Admiral Strauss recently pointed out that the first Russian hydrogen bomb, which came only a relatively few months after our first one, with which we had a lot of difficulty, actually was probably better and more cleverly designed than our first one.

Situation Critical

Make no mistake, we face a very serious situation. At the present time the determined groups behind the Iron Curtain, not only in Russia but in all the satellite states, have made the development of science and engineering, and the management and technology that flow from it, the keynote of their national policy. With about 60 per cent of the present Politburo composed of engineers, we are up against professional competition of the most serious sort. At present, about 4000 research institutes are attached to Russian universities, or are operating independently. The Russian engineer and the scientist have a far higher differential between their wage scales and the lowest-paid Russian worker than prevails in this country.

Drawbacks of Mass Education

In this country our basic educational practices for the past 50 years have been devoted to a philosophy of mass education. While mass education certainly has given our country great strength in one sense, on the other

---

Address delivered at the Annual Meeting Banquet, New York, N. Y., December 1, 1954, of The American Society of Mechanical Engineers. Slightly condensed.

hand our primary and secondary educational system is in grave danger of starving out our professional classes, upon which the welfare and security of this nation depend.

High school after high school in this country has abandoned all laboratory courses. In many states less than half of the high schools are now giving mathematics or laboratory science courses which would qualify students for entrance into the average engineering school.

While total high-school population has been climbing steadily, the number of graduating students, who are qualified by knowledge of basic mathematics, physics, and chemistry, to undertake professional training in engineering, science, or medicine, has gone down steadily. As a matter of fact, the number decreased 11 per cent again last September. This situation has been at the danger point for four or five years and only now is beginning to show a slight turn for the better.

As it stands, nothing can be done to prevent the Russians from gaining on us in scientific and technical manpower by a ratio of 2 to 1. Already we have lost the battle for engineering manpower—at least in numbers.

Provide Opportunity for Qualified Students

We have been devoting our efforts to mass education without reference to the great need of our country for people of advanced education and without providing an opportunity for those who have the aptitude and intelligence to go forward in engineering and science. If we do not develop a basic educational philosophy that permits every young man and woman to advance who has the intelligence, aptitude, and drive, then we certainly have all failed in our responsibilities. Surveys show that probably less than one half of those who have the intelligence and qualifications to be engineers are even getting into college. They have been discouraged along the line by the environments in which they live.

I do not pretend to have a solution to all these difficulties, but it is time we gave serious thought to the matter, because the very civilization that we have built up so quietly and so effectively has not been "sold" properly. We engineers and scientists have not made our fellow citizens realize the basic underlying strength that has made this nation great. Somehow we have failed very badly in our own public relations. We are taken for granted and, as a result, there is grave danger of losing the showdown for the world. These are exceedingly serious days.

The Nation's Strength

Over the past 50 years, intensive use of our sources of energy—water power, coal, petroleum fuels, natural gas—made possible the development of machines to translate the raw materials of the earth into the abundance that exists around us. Measured by any index, this nation produces roughly one half of the world's entire output of commodities—in spite of the fact that we constitute only 6 per cent of the world's population.

This ability to produce for the good of mankind cannot be utilized under the constant threat of war. Perhaps with nuclear weapons we have reached the point where we have made war so horrible that it becomes an absurdity. Possibly this releases a hope that if we do

We are at the crossroads where our competitors on the other side of the Iron Curtain have decided to use engineering knowledge with a vengeance and have made it the complete instrument of national policy. In such hands this power will be used to enslave the world. While we have a long head start, they are overtaking us very rapidly. To solve the problem, the engineer and the scientist must be accepted by their fellow citizens as constructive and dynamic factors in our civilization. Industry as a major channel for our national income must accept real responsibility in this situation, but industry's support is still small even though there are encouraging trends.

not have war, then the battle for the world will be decided on the basis of who can deliver the goods, food, clothing, and shelter most effectively and efficiently to an increasing proportion of the world's peoples.

Limiting Factors

The plain fact is, however, that even with all the knowledge, science, and technology which we can bring to bear on the problem, there is not sufficient fossil energy in the form of coal, oil, and water power combined to improve the living standards of more than a small proportion of the world's population. Possibly a level equivalent to ours could be attained by a fourth of the peoples of the world. As we move ahead into the next 25-year period—toward the one-hundredth anniversary of this Society—the answer must come from the development of atomic power—utilized in every possible application from central power stations to package reactors, in ships, airplanes, and even locomotives.

In uranium we have one definite solution to the world's growing energy deficit. This element is a source of energy many times greater than that of coal and oil. It is the only conceivable source through which any appreciable fraction of the people on this earth can be liberated from basic slavery and provided with more than the bare essentials of life. The only possible solution to the problem—whether provided by the communists or by free men—is a steadily increasing use of science and technology.

The engineer and scientist must be accepted by their fellow citizens as basically constructive and dynamic factors in our civilization. At the same time we must recognize that responsibility goes hand in hand with opportunity. In our duty to mankind here and throughout the world, we must steadily raise the standard of living and, thereby, the standard of human decency and human dignity. In a sense, freedom can come only through the spirit that the engineer makes possible. Engineers will be equal to the task and the future will see the human race avoid another catastrophic war. We are moving forward in the constructive use of the engineering and the science that we stand for and in which we so deeply believe.

Free-Piston Gas-Turbine Prime Movers . . .

A Review of Basic Principles

By A. J. Ehrat

Baldwin-Lima-Hamilton Corporation, Hamilton, Ohio

- Advantages
- The "Brayton" Cycle
- Gasifier Configurations
- Model DL Gasifier
- Working Principles

Active American evaluation of free-piston gas-turbine prime movers has been continuing since before the end of World War II, although on a very limited scale in proportion to that of gas-turbine prime movers as a whole. During the early years the fundamental work was carried on through the efforts of the U. S. Navy Bureau of Ships and the author's company, but now at least two other firms are engaged in separate evaluations. There are also many other signs indicating a general spreading of interest.

Why the Free-Piston Gas Turbine

The extent to which free-piston gas-turbine machinery will be applied cannot be predicted with accuracy at this time but it is the author's conviction that such equipment can take its place beside other successful prime movers. In comparison to diesel engines, free-piston machinery has inherent advantages of lower specific weight, lower maintenance costs, greater flexibility of arrangement and operation when used in multi-gasifier plants, and greater possibility of delivering large amounts of power to a single shaft.

Free-piston machinery has an efficiency advantage over small steam or simple-cycle gas-turbine plants. Also, in comparison to steam or complex-cycle gas-turbine plants, the hazard due to the escape of large quantities of high-temperature working fluid from large boiler or receiver-type volumes is virtually eliminated.

Thermodynamic Cycle

The basic elements of a free-piston-gasifier gas-turbine plant are a pair of single-stage reciprocating compressors,

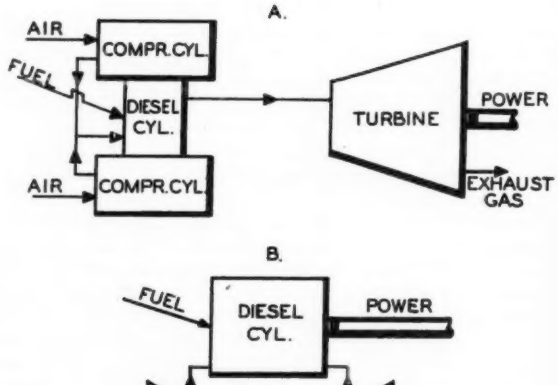


Fig. 1 Flow diagrams showing (*A*) free-piston gas turbine; (*B*) turbocharged diesel engine; and (*C*) simple-cycle continuous-combustion gas turbine

a two-stroke-cycle opposed-piston diesel cylinder which is coupled to the compressors, and a power turbine. As shown by the schematic flow diagram, Fig. 1(*A*), air drawn from the atmosphere by the compressors is compressed and delivered to the diesel cylinder, where it is compressed further. Fuel is then injected and burned, and the combustion products are expanded partially in the diesel cylinder and the rest of the way in the turbine. The power developed by the diesel cylinder drives the compressors, and all of the power developed by the turbine is delivered to the output shaft.

Fundamentally, the free-piston gas-turbine plant employs the same ideal thermodynamic cycle as do its better-known counterparts, the turbocharged diesel

Contributed by the Railroad Division and presented at the Annual Meeting, New York, N. Y., November 28–December 3, 1954, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 54—A-67.

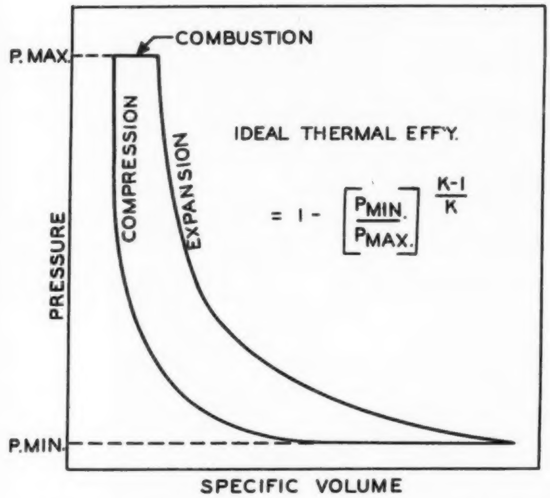


Fig. 2 The free-piston gas-turbine plant employs the constant-pressure or Brayton cycle

engine, Fig. 1(*B*), and the simple-cycle continuous-combustion gas turbine, Fig. 1(*C*). This cycle involves isentropic compression of air drawn from the atmosphere, constant-pressure combustion in this air, and isentropic expansion to atmospheric pressure. It is commonly known as the "constant-pressure" or Brayton cycle, Fig. 2.

Although all three of the prime movers operate on the same thermodynamic cycle, important differences result from the several methods by which the processes of that cycle are effected. The free-piston gasifier and the diesel engine both use an engine cylinder in which combustion is carried out intermittently, whereas the gas-turbine plant employs a chamber in which fuel is burned at a relatively steady rate. Therefore, because much higher maximum cycle pressures and temperatures are permissible in the diesel cylinders of the gasifier and of the diesel engine, the cycle efficiencies of the two are comparable. Furthermore, even though the maximum cycle temperature is higher, the temperature at the turbine inlet can be appreciably lower than that of the continuous-combustion gas turbine because a major portion of the expansion is carried out within an engine cylinder.

Gasifier Configurations

All existing free-piston gasifiers are symmetrically arranged to contain a central diesel cylinder flanked by a pair of compressor cylinders and by one or more pairs of bounce, or cushion, cylinders, Fig. 3. A composite diesel compressor-bounce piston assembly is housed within each half of the machine. By reason of the symmetry of the gasifier, at any particular instant both piston assemblies are displaced the same distance outward from the center line and the primary forces, accelerations, and velocities involved are equal and opposite in direction. In other words, the gasifier enjoys inherent dynamic balance, a trait which permits use of simple supports rather than a heavy foundation.

In spite of the design symmetry of the gasifier we may expect relatively small differences between the forces on the two piston assemblies, resulting from secondary variations in friction coefficients, valve action, and the like. Therefore the two pistons must be connected by a light mechanism which insures synchronization but which does not otherwise limit or control motion. This synchronizing mechanism may consist either of a pair of toothed racks operating on a common pinion gear, or of a system of linkages. It has another very important function in that it is used also to drive the fuel pump and to time the injection of fuel.

The gasifiers which have actually been built may be classified as one or the other of two basic types. They are either outward-compression machines, Fig. 3(*a*), or inward-compression machines, Fig. 3(*b*), depending on the direction in which the pistons move during the compressor-cylinder compression and discharge period. Each type, of course, can have a number of variations.

Fig. 3(*c*) depicts the inward-compression-type variation which involves the use of adjustable compressor heads. This is the machine which will be used to illustrate the principles of free-piston gasifiers.

Model DL Gasifier

A more detailed sectional view of an inward-compression-type machine with adjustable compressor heads is shown in Fig. 4. It is the Baldwin-Lima-Hamilton model DL, a high-output unit developed for the U. S. Navy Bureau of Ships.

The gasifier actually under test has an 8-in. diesel

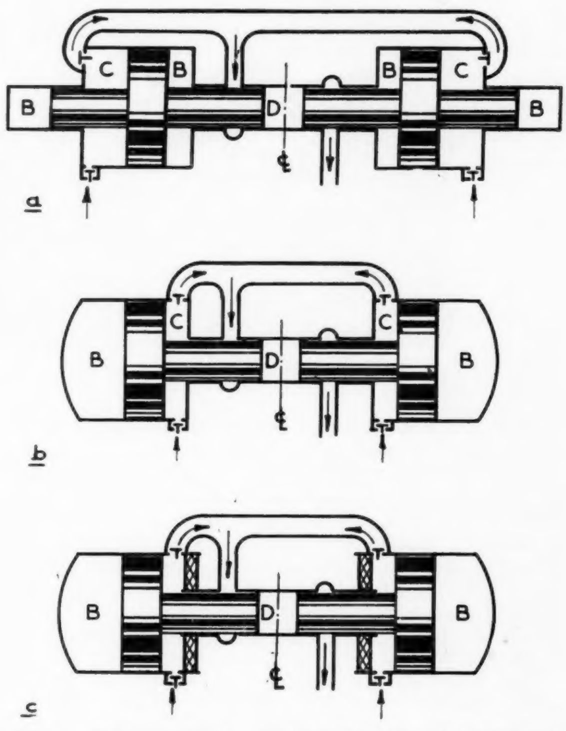


Fig. 3 Basic types of free-piston gasifiers: (*a*) Outward compression; (*b*) inward compression; (*c*) inward compression with adjustable compressor heads

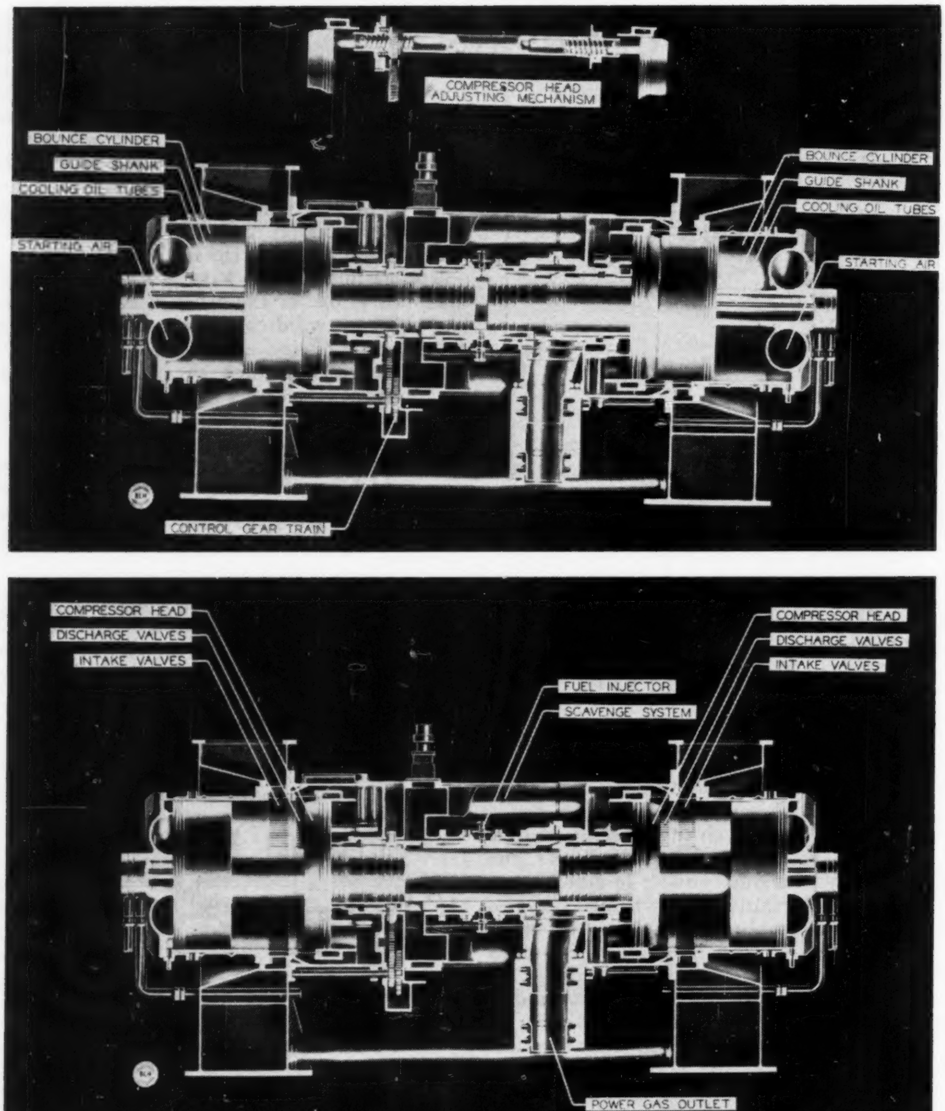


Fig. 4 BLH model DL gasifier, a high-output unit developed for the United States Navy Bureau of Ships

cylinder bore, a 22-in. compressor-and-bounce cylinder bore, and a nominal net stroke of $10^3/_4$ in. Its speed is of the order of magnitude of 1000 cycles per min. Nominally the machine is rated at 700 gas horsepower which implies an output, at the shaft of an 85 per cent efficient turbine, of around 600 hp. Actually it has already delivered as much as 830 gas horsepower, corresponding to 700 shp, during laboratory tests. The prototype machine has accumulated several thousand hours of operation, including a successful 500-hr official Navy endurance run.

The model DL free-piston gasifier has been operated only on distillate fuel oils. The satisfactory combustion in the gasifier of lower grades of fuel, such as the residuals, is entirely possible but has not as yet been investigated because of the priority assigned to other work.

Working Principles

The events during each cycle of the pistons occur as follows, Fig. 5. The composite pistons are driven outward by the expanding combustion gases of the diesel cylinder and by the expanding air of the compressor-cylinder clearance volumes. Air is drawn into the compressor cylinders, and air contained within the bounce cylinders is compressed for storage of energy. Near the outer end of the stroke first the exhaust ports and then the scavenge ports are uncovered by their respective diesel pistons, consequently releasing the combustion products to the turbine and permitting fresh high-pressure air from the scavenge system to enter and purge the cylinder. The pistons are then returned inward by the energy stored in the bounce cylinders. The

ports are closed off, the air charge thus trapped within the diesel cylinder is compressed, and the air previously drawn into the compressor cylinders is compressed and delivered to the scavenge system. Near the inner end point of stroke a metered quantity of fuel is injected into the diesel cylinder, causing repetition of the entire process.

The functioning of the free-piston machine is characterized by the fulfillment of two basic requirements. During each cycle of the pistons there must be a complete internal balance of work and during each stroke of the pistons there must be a complete balance of energy.

The first requirement, that the work shall balance, arises from the fact that the gasifier is only pneumatically linked to the load and therefore cannot deliver any external mechanical power. Because of this, all the indicated work of the diesel cylinder must be absorbed and balanced by the other components of the gasifier. Specifically, the work of the diesel cylinder is balanced by the work of the compressor cylinders plus that of friction. This work balance is not a precarious one. On the contrary, within the broad operating range of the machine it is wholly automatic and is the basic means for adjusting power output.

The second requirement, that the energies shall balance, is attributable to the facts that the pistons reverse direction at each end point of stroke and that there are no rotating masses to carry kinetic energy over from one stroke to the next. Thus, during each stroke, all the energy delivered to the pistons must have been absorbed from them by the time the extremity of stroke is attained. For example, during the outward travel of the pistons the expanding gases in the diesel cylinder

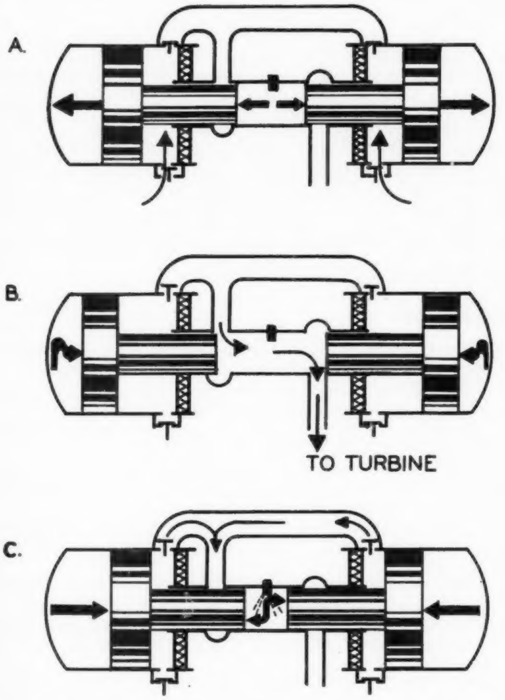


Fig. 5 Diagrams showing cycle of events: (*A*) Pistons driven outward; (*B*) outer end of stroke; (*C*) pistons returned inward

and the expanding air in the compressor-cylinder clearance volumes transfer energy to the pistons, where it appears as kinetic energy. This energy subsequently is absorbed and balanced by the air in the bounce cylinders and by the comparatively small amount of friction.

Because of the energy-balance characteristic we may conclude that a free-piston machine contains no mechanical "flywheel effect." This is a unique advantage, for the machine can be brought up to speed swiftly after starting, can change load rapidly, and can be stopped instantly and safely in an emergency.

Principle of Piston Motion

The underlying principle of piston motion is much the same as that of a system composed of a mass oscillating between opposed springs. Although in the gasifier system the "springs" are pneumatic rather than mechanical, in both systems one spring projects the pistons against the other and the surplus energy released by the first subsequently is absorbed and balanced by the other. Because the point at which the stroke terminates and the motion reverses is the point where the balance of these two energies is complete, it may be shifted by alteration of the energy conditions through adjustment of the constants and working levels of the springs. As is true also of the mass of the spring-mass system, the gasifier pistons operate at a natural frequency which is a function of the reciprocating weight and of the force-versus-stroke characteristics of the springs.

Hence we observe that the motion of the pistons is rational even though not subjected to the inflexible restraint of the conventional crank-connecting rod mechanism, and that it is "free" only in the sense that it is free to be controlled through application of the work- and energy-balance principles. This freedom of control permits adjustment of stroke end points to suit the requirements of each operating situation.

Adjusting Stroke End Points

Adjustment of stroke end points obviously implies simultaneous adjustment of net stroke length and of piston displacement. Therefore it implies also a tendency to vary the air delivery of the compressors and the gas delivery and the gas-power output of the gasifier.

The outer end point is basically more effective for stroke-length adjustment than is the inner, because it can be varied over a much greater range. This range, which is of the order of 20 per cent of the nominal piston stroke, falls between an end point so great that the minimum safe operating clearance from pistons to bounce-cylinder heads is encroached upon and one so small that the scavenge ports are choked beyond the limit of stable gasifier operation.

The adjustability of the inner end point is at least as significant as is that of the outer end point, because it is used to adjust the diesel-cylinder compression ratio. As a result, the diesel-cylinder compression and firing pressures may be controlled throughout the load range.

Compressor Clearance Volume

Another variable which has particular influence on the operation and power output of a gasifier is the clearance volume of the compressors. The theory of reciprocating compressors tells us that for high volumetric efficiency

this clearance should be as small in proportion to the displacement as possible. This requirement assumes added importance as the pressure ratio is increased.

On an outward-compression gasifier the outer end point of stroke governs the clearance volume. This relationship is reasonably satisfactory, the only objection being that there is a slight variation of the position of this point from cycle to cycle and as a result the linear clearance of the compressors cannot with safety be reduced quite as much as might be desired.

On an inward-compression gasifier the inner end point of stroke governs the clearance. This is an advantage because the inner end point is very steady. Unfortunately, the advantage gained is clouded by the fact that now compressor clearance is coupled also to diesel-cylinder compression ratio. For a machine of high specific output such an alliance is detrimental because the requirements of these two very important operating variables conflict. That is, as turbine-inlet pressure rises, on the one hand compressor clearance should decrease or should at least remain constant in order that highest volumetric efficiency may be maintained, but on the other hand diesel-cylinder clearance should increase in order that compression and firing pressures may remain at reasonable values. Whereas the first consideration demands a reduced or at least a constant inner end point of stroke, the second consideration demands an increased one. The opposing requirements can be compromised to a certain extent up to moderate turbine-inlet pressures, say, 50 psig, but at higher pressure the differences become too great for practical operation. Even at lower pressures, the necessary compromise tends to reduce the specific output as well as the operating flexibility of the gasifier.

On an inward-compression gasifier with adjustable compressor heads there is no need for such a compromise because the compressor clearance is basically divorced from the stroke end points. Aside from the fact that the steadiness of the inner end point permits continuous operation with a very small compressor linear clearance, which can be as little as 1 per cent of the net piston stroke, neither the inner nor the outer end point has a primary influence on the choice of compressor clearance. The resulting separation of compressor-clearance control from that of diesel-cylinder compression and firing pressures is especially advantageous because the machine can be operated under conditions which are optimum as regards endurance, thermal efficiency, and specific power output.

Whereas the inward-compression machine with fixed compressor heads is limited as to maximum turbine-inlet pressure, that with adjustable heads can be operated at any pressure which it can physically withstand. In this respect the latter has an advantage in common with the outward-compression gasifier. An additional advantage is its capacity for operating at appreciably lower turbine-inlet pressures than can gasifiers of the other two designs. This means that the inward-compression gasifier with adjustable compressor heads can idle more easily against a turbine.

Compatibility of Gasifier and Turbine

The mechanical power delivered at the turbine shaft is the product of the adiabatic turbine-shaft efficiency and of the adiabatic gas power delivered by the gasifier. A gasifier, when operated as a separate entity, can furnish each desired value of gas power in the form of many different combinations of gas flow, gas pressure, and gas temperature. If the gasifier were operated against a turbine equipped with an infinitely variable nozzle area the combined plant could enjoy the complete operating flexibility of which the gasifier is capable. Such a goal would, however, require very complicated controls because each power requirement could be satisfied by an infinite number of gasifier and turbine operating conditions. Therefore it is likely that, even in the particular applications where a variable-nozzle-area turbine might be used, a definite schedule of area variation would be adopted.

In most instances, however, a turbine having a fixed nozzle area is all the free-piston plant requires. The actual value of this area is chosen at the outset of the application study and depends on the nature of the specified installation. Generally speaking, smaller nozzle areas permit the attainment of higher maximum powers because the gasifier can supply higher pressures and temperatures before it reaches its gas-flow limit. On the other hand, smaller nozzle areas also imply higher pressures and temperatures for each absolute value of part-load power and thus involve more severe operating conditions. Hence smaller nozzle areas would be chosen for applications requiring higher powers for short periods of time, as is true for many naval combatant vessels, and larger nozzle areas would be chosen for continuous full-power installations.

Once the nozzle area of a fixed-nozzle-area turbine has been chosen, the delivery characteristics of the gasifier must match the consumption characteristics of the turbine at all loads.

Conclusion

In conclusion it may be stated that the text of this paper forms only an introduction to the principles of free-piston gas-turbine prime movers. The principles themselves are neither fundamentally new nor, it is hoped, difficult to understand. It is necessary only that they be approached objectively. For additional, more specific, information concerning this interesting application the engineer is referred to the literature, some excellent examples of which are given in the references which follow.

BIBLIOGRAPHY

1 "Steam and Gas Turbines," by A. Stodola and L. C. Loewenstein, Peter Smith, New York, N. Y., vol. 1, 1945, pp. 316–317.

2 "Freikolben-Generatoren," by G. Eichelberg, *Schweizerische Bauzeitung*, 66 Jg., Nr. 48, pp. 661–667; 66 Jg., Nr. 49, pp. 673–679.

3 "The Case for the Free-Piston Gasifier," *The Oil Engine and Gas Turbine*, vol. 18, no. 213, March, 1951, pp. 353–356.

4 "The Free-Piston Engine Development—Present Status and Design Aspects," by A. L. London and A. K. Oppenheim, Trans. ASME, vol. 74, 1952, pp. 1349–1361.

5 "The Free-Piston Type of Gas-Turbine Plant and Applications," by J. J. McMullen and R. P. Ramsey, Trans. ASME, vol. 76, January, 1954, pp. 15–29.

6 "Performance of Free-Piston Gas Generators," by J. J. McMullen and W. G. Payne, Trans. ASME, vol. 76, January, 1954, pp. 1–13.

7 "The Development of High-Output Free-Piston Gas Generators," by R. A. Lasley and F. M. Lewis, Trans. ASME, vol. 76, April, 1954, pp. 453–462.

8 "The Free-Piston and Turbine Compound Engine—A Cycle Analysis," by A. L. London, Trans. ASME, vol. 77, February, 1955, pp. 197–210.

9 "Compound Gas Prime Movers," by J. Shapiro, *The Engineers' Digest*, vol. 15, no. 1, January, 1954, pp. 5–8, 36.

Possible Energy Trends

An appraisal of energy from nuclear sources in comparison with conventional sources of power

By D. P. Barnard

Assistant Secretary of Defense for Research and Development, Washington, D. C. Member ASME

THE ENERGY from nuclear reactions shows up mainly as heat. The heat portion only can be used—in the light of present know-how—for the production of power or for any other "constructive" purpose. Heat is merely one form of energy and therefore carries with it the implication that it can be transformed into any other required energy form. However, many prolific sources of heat are economically unusable with present technology. For example, an enormous amount of heat energy is stored up in the sea, but its temperature level is so low that it cannot be employed profitably—at least not at present. The same is essentially true of tide, wind, and low-head hydraulic-energy sources. Even solar energy, while generated in fantastic amounts and at extremely high temperature levels, is economically unsuitable for serious power production or for direct use as a heat source. From a practical standpoint, we must seek forms of heat which can be converted into other types of energy on a convenient and an economically attractive basis.

The Sun as an Energy Source

Just why is there such intense interest in "man-made" nuclear energy at this time when, after all, the sun is a nuclear reactor producing energy on a vast scale? It has been estimated that the total amount of solar energy striking a 5-degree-wide band of the earth's surface each 24 hours at the equator is roughly equivalent to that released by one million Hiroshima-type atomic bombs. Presumably the total amount of energy reaching the earth's surface, therefore, would be much greater. With these enormous amounts of energy coming to us free, and due to continue for countless milleniums, it would seem that we should be willing to go to considerable lengths to capture substantial quantities of such energy. The troubles with the solar-energy picture are (1) it arrives at the earth's surface at a comparatively low level of temperature or radiation intensity; (2) it is not continuously or reliably available (particularly in the more heavily populated latitudes); (3) since we have no control over its availability, we would either have to capture it in large quantities for storage until needed or support it with stand-by artificial power generation. As we know, either procedure is out of economic reach.

In essence, the nuclear reactor has been looked upon as a sort of "private sun" which is not subject to the drawbacks of solar energy. While this is essentially true, artificial nuclear-energy generation has its own practical limitations—at least within the limits of current know-how. The most readily usable form is that in which the nuclear reactor replaces the conventional firebox as a source of heat. From there on the system becomes reasonably conventional, although for reasons peculiar to nuclear processes, certain additional problems must be recognized. The net result is that, in addition to the bulk and weight of a conventional steam plant, for example, we must paint into the picture requirements for radiation shielding and other unique provisions which make the entire installation bulkier and much heavier than a conventional plant of given output.

Comparison With Steam Plant

A good picture of the pros and cons of nuclear power generation can be obtained by comparing a nuclear power plant with a conventional steam plant. The main difference will be in the heat source itself and, as usual, there must be some trading of advantages and disadvantages. Nuclear generation essentially eliminates fuel transport and storage but, in return, imposes the need for the expensive, somewhat bulky, and (with its shielding) considerable reactor weight.

Fuel costs for nuclear energy are not negligible. It has been imagined frequently that, once a nuclear source is put to work, it goes on forever, much as the sun itself appears to do. This is not true, and the life of any nuclear fuel is definitely limited and must be replaced just as in the case of coal or any other conventional fuel. While the bulk and weight of nuclear fuel that must be handled is negligible in comparison with conventional fuels, the costs are not, and as a matter of fact, nuclear fuel costs are likely to exceed the cost of more conventional fuels for some time to come, although, under favorable conditions, they may be competitive.

The radiation problems associated with the use of nuclear fuels are widely recognized to be serious. For this reason, accessibility to the nuclear-energy generator is limited and many additional, and usually expensive, features are required to enable personnel to live and operate in the vicinity and particularly to perform the necessary maintenance operations. The refueling operation itself, when it becomes necessary, can be quite involved. The problem of disposing of the highly radioactive ash from the nuclear furnace is a particularly knotty one. Lastly, the sheer size limitations on nuclear-energy generation seriously limit its applicability to motive power.

Presented at the Fuels Division Luncheon held at the Annual Meeting, New York, N. Y., November 28–December 3, 1954, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Slightly condensed.

Logistics the One Great Advantage

To summarize, while nuclear-energy generation has certain attractions, the chief one, and perhaps the only one worthy of serious consideration at this time, is its contribution toward the solution of certain critical problems of fuel logistics. The increased costs and disadvantages of nuclear energy must be justified by its advantages in other areas. The fact is that the application of nuclear power must be subject to, and must survive, rather jaundiced economic scrutiny except, of course, for those military needs where its peculiar abilities dictate its use without regard to cost—for example, in the submarine. Such military applications, of course, may contribute toward the development of industrial applications.

Mainly, however, it is expected that such military uses will contribute progressive technical know-how rather than inspire a revolution in the field of industrial power generation.

Reversing the Perspective on Power

Perhaps our perspective on the place for nuclear power can be sharpened by looking at the picture in reverse. If we can imagine our only source of energy today to be nuclear power, we would be searching very hard for alternative sources which would give us greater flexibility in utilization and save capital investment even at the expense of increased fuel costs. Coal would appear to be a godsend as it would permit the construction of cheap and small power plants by comparison with those dictated by the peculiarities of nuclear energy. Coal would make possible a peripatetic power plant which would greatly extend the usefulness of our railroads, and the iron horse would appear attractive indeed. Coal also would contribute comfort heat in small packages over areas of diffused population where otherwise such heat would not be available. The advent of coal would make possible the population of otherwise unacceptable areas. Coal also would contribute industrial power in small quantities where it might not otherwise have been practical. It would even make possible elemental power farming, and the old-time steam traction engine would have a great appeal. In short, the advent of coal to a world subsisting solely on nuclear energy would greatly expand the development of industrial power, heat, power farming, and transportation.

The next step in our backtracking would, of course, lead us to the use of gaseous fuels. Here we would have an extension and amplification of stationary power generation but practically no contribution to energy generation for motive power. The same considerations, of course, would apply to hydroelectric power.

Internal-Combustion Engine—Tops

Now if, after having worked our way through all of the various sources of stationary energy, someone introduced the liquid-fueled internal-combustion engine (which gaseous and liquid fuels make possible), the revolution in our industrial, civil, and military ways of life would be most spectacular. Here at last we would have a scheme for converting fuel energy into power in any desired quantity—large or small—and unfettered by ties to a nonmovable energy source. The essence of the internal-combustion engine is that it converts heat directly into mechanical energy inside the reaction vessel itself. It thereby eliminates the boiler with its accompanying problems of water supply and the complex controls which are dictated by the fact that heat liberation, transfer, and conversion to power are conducted separately, must be individually controlled, and these controls intimately co-ordinated. By the elimination of these intermediate steps, the cost and weight of the power-generating apparatus can be brought down to relatively low levels. As a matter of interest, a modern automobile engine can be purchased ready to run and complete with all necessary accessories for as low as $2 per "advertised horsepower." In addition to the low cost and weight made possible by the internal-combustion engine, its simplicity of operation, and its fantastic reliability have contributed immensely to both our civil and military progress.

The simplicity of operation and built-in automaticity of the internal-combustion engine, together with its over-all reliability, bring the automotive vehicle in all of its forms to practical accomplishment. From our imagined starting point of a solely nuclear-energy economy we would, therefore, find that not until the advent of liquid fuels would the automobile, the truck, the farm tractor, and the airplane become entirely practicable and acceptable.

Since the purpose of this brief presentation is to appraise the probable position of nuclear power in the foreseeable future, it would seem that a qualitative assessment of the different energy sources is about as given in the accompanying table.

Box Score of Energy Sources

	Economic potential	Fixed costs	Fuel costs	Versatility
Hydroelectric.	Small	High	None	Very poor
Coal.........	Large	High	Medium	Poor
Gas..........	Large	Moderate	Medium	Fair
Liquid (petroleum)......	Large	Least	Moderate	Very good
Nuclear......	Large	Very high	High to medium	Limited

Outlook for Nuclear Power

Nuclear power is due to develop markedly in the next decade or so. First applications naturally will be made where full advantage can be realized from its unique properties—relative independence from a continuous fuel supply. To this, in time, will be added applications where economics indicates a tolerable disadvantage combined with an attractive opportunity for profitable development. Since power production in these United States seems bent on doubling about every ten years, a place for nuclear-power reactors appears logical without too much impact on the further development and installation of conventional power sources. As a wild guess, one might expect nuclear power to assume, over a substantial number of years, a role about on par with hydroelectric power. Where adequate conventional energy sources are available, one should expect development to follow the established pattern. In the motive-power field, particularly, liquid fuels, burned in the gasoline engine, the diesel, and the combustion turbine will continue to carry the lion's share of the load. Nevertheless, it will be interesting to watch the evolution of nuclear power during the coming years as it "finds its place in the sun."

Heat Processing Combustible Material . . .

. . . by high-temperature gas-generated radiation and by direct flame impingement

By C. P. Mann

Manager, Drying Division, Selas Corporation of America, Philadelphia, Pa. Life Member ASME

Benefits of Heat Processing

- *Improved product quality*
- *Increased production rates*
- *Reduced sizes of equipment*
- *Conveyerized heat processing*
- *Improved continuous processing*
- *Reduced unit-production costs*

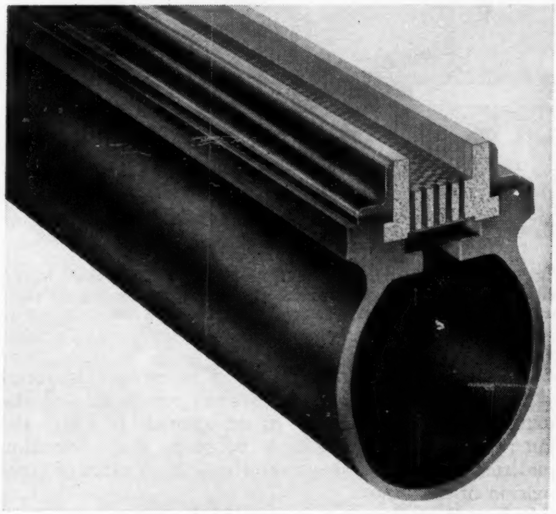


Fig. 1 Section through ribbon burner of the type used in flame-impingement method of heat processing

It has been customary, in heat processing such combustible materials as textiles, paper products, synthetic fibers, and plastics, to apply the heat at as low a temperature as practical in order to avoid the risk of spoilage. This approach, however, results in large bulky heat-processing equipment, requiring correspondingly long processing times and relatively high labor and maintenance costs.

A newer heat-processing concept of achieving exceedingly high rates of heat transfer by employing extremely high temperature differences between the applied heat and the work, has shown remarkable results in the heat-treatment of metals and other noncombustible materials. It is now being applied to various combustible materials and is showing significant production economies and outstanding product improvement.

New Techniques Developed

Two techniques have been used successfully in a number of cases to adapt this new concept of heat processing to combustible materials, namely, direct flame impingement, and high-temperature gas-generated radiation.

It has been established that heat processing of many products composed of combustible materials, such as those just mentioned, involves a time-temperature relationship such that the higher the temperature applied, the shorter the processing time. The equipment required for the treatment also becomes more compact.

The two selected techniques of attaining high rates of heat transfer—exposure of the work to direct flame contact, and exposure to high-temperature radiation—are in some respects, two of the most convenient means for utilizing heat at higher thermal heads.

Flame-Impingement Method. The flame-impingement application presented in this paper involves the use of gas flames of high heat intensity and uniformity over their entire length, produced by multiported burners specially designed to burn a stoichiometric air-gas mixture, forced under pressure through the burner ports. In appearance, the flame is blue and very "stiff," that is, the flame velocity and rate of combustion are so rapid, and the flame is so securely rooted to the burner itself that the burner is enabled to give a positive direction to the flame and deliver its heat at the desired location in spite of extraneous air currents or similar hindrances.

Fig. 1 shows a section through a ribbon burner representative of this type. It consists essentially of three parts: viz., the burner manifold to which the air-gas mixture is fed under pressure; the deep burner ports,

Contributed by the Fuels Division and presented at a joint session of the Gas Turbine Power and Fuels Divisions at the Annual Meeting, New York, N. Y., November 28–December 3, 1954, of The American Society of Mechanical Engineers. Condensed slightly from ASME Paper No. 54—A-163.

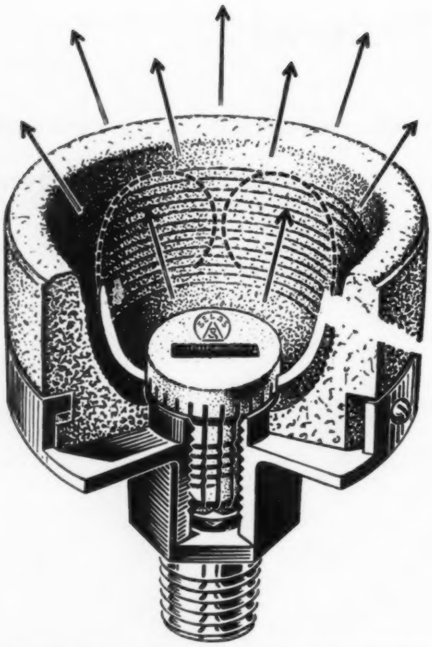


Fig. 2 Burner in which stoichiometric air-gas mixture burns within a cup-shaped ceramic cavity, which, becoming radiant, permits directing heat at desired intensity to work

which in this instance are formed in ceramic material as a heat-insulating barrier between the flame and the manifold; and a ceramic cavity or "tunnel" in which the flame originates and which provides flame-retention qualities of a high order, permitting high rates of combustion of the gases.

Radiant-Heat Technique. The high-temperature radiant-heat application involves the radiant-heat energy given off from a ceramic surface, heated by a gas flame. One means of attaining this result is to cause a gas flame to burn along the surface of a heat-insulating ceramic body. A part of the heat of combustion of the gas flame is thereby converted to radiant heat, because the insulating characteristics of the ceramic material cause its surface temperature to rise rapidly to a temperature in the order of 2000 F. The heat is then radiated from this surface to surrounding bodies in proportion to the difference of the fourth powers of the temperatures of the radiant surface and of the surrounding bodies.

Fig. 2 shows one type of gas radiant burner in which a stoichiometric air-gas mixture emerges under pressure through ports at the center of a cup-shaped cavity of a heat-insulating ceramic body in such a way that, when this gaseous fuel is ignited, it burns completely within the cavity and along the inner surface of the cup. The cup, becoming radiant, transmits its heat by wave motion in the same way as, and at the velocity of, light. This design of burner permits directing the radiant heat, which penetrates intervening air currents without hindrance, at the desired intensity, to the work.

Applications of the Processes

Heat Processing Polyethylene Film. Because the heat of direct flame-impingement or high-temperature radiation generated by the burners described in the foregoing can be directed to the surface of a film at high intensity, and can be controlled accurately within very close tolerances, these methods have been applied extensively and most successfully in the heat processing of polyethylene film to prepare the surface for printing.

The burner equipment is very compact, and mechanisms have been devised for physically moving the burners, when such movement is desired. This movement may be synchronized with process operations, making it possible to start and stop the film without danger of damage, because the high-intensity heat may be applied instantly, or withdrawn instantly in response to the film movement.

The printing on polyethylene film presents a real problem. Until the surface of this material has been treated, it will not retain printing ink. It has been discovered that if just the surface of this film is heated to a temperature of 825 F, a chemical change takes place, making the surface ink-receptive. Subsequent printing will adhere readily, permitting the material to be handled without damage to the printed surface.

However, at about 450 F, polyethylene film is destroyed, so the problem is to sear 0.0004 in. of the film surface and yet prevent the remaining body of the film from becoming overheated. This is accomplished in a process by an extremely high-temperature exposure for a fraction of a second.

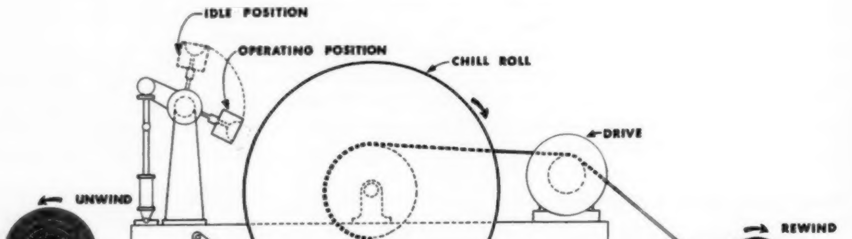


Fig. 3 Schematic diagram of procedure for the radiant-heat processing of plastic film

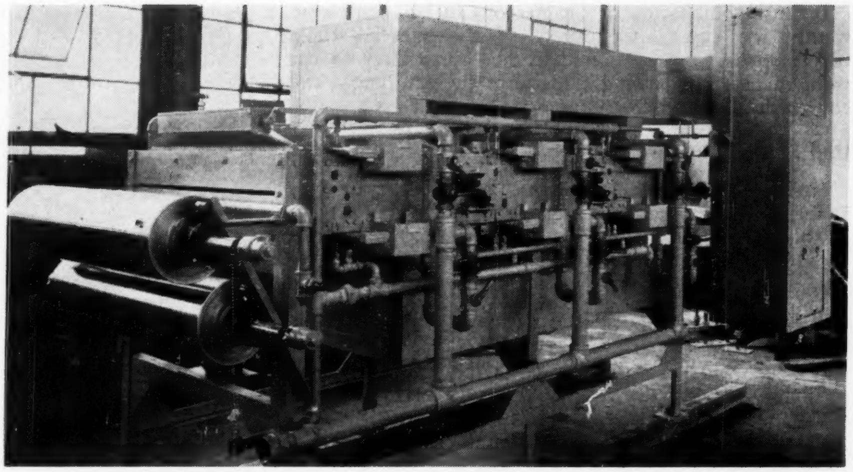


Fig. 4 Direct-flame-impingement-burner oven for laminating aluminum foil to a paper web

Fig. 3 is a schematic illustration of how this heating process is performed. The film is fed continuously at the desired speed and is wrapped around and held in intimate contact with a chilled roll, while at the same time the outside surface of the film is subjected to the high-intensity heat. Physical movement of the burner, actuated by starting or stopping the film, may be by rotation of the burner, or by lifting away.

The radiant gas burner just described, which enables radiant heat to be directed and distributed uniformly over a plane surface at an accurately controlled high thermal head, combined with a mechanism for mechanically removing this heat very rapidly in synchronism with production machine operation, has been applied to the production of imitation leather and in the drying of gummed paper to such good effect that production rates have been increased remarkably and valuable floor space saved.

Producing Imitation Leather. In the manufacture of imitation leather, a synthetic coating is applied on cloth by a continuous process, and this coating is fused to the cloth, and cured by heat. Subjecting the coated surface of this material to the high-temperature radiant heat completes this heat process in a matter of seconds.

Drying Adhesive on Gummed Paper. In drying adhesive, which has been coated on gummed paper, the high rate of heat transfer, made possible by gas-generated, high-temperature radiation, permits a substantial increase in production rate without any increase in labor cost or floor space.

Laminating Aluminum Foil. In laminating a web of aluminum foil to a paper web, one surface of the aluminum foil is coated with a water-soluble adhesive. This coated side is pressed against the paper web, and the laminate is dried and cooled before it is rewound into a roll for shipment. The direct-flame-impingement burner oven, shown in Fig. 4, is designed to perform this laminating operation. This is a critical drying operation because if sufficient moisture is not removed, the bright finish of the aluminum surface will become tarnished while in storage in the roll; and if too much is removed, the laminate becomes brittle. This oven increased the rate of production more than two times for the same floor area and without any increase in labor over the former low-temperature application.

Paper Laminates. Another laminating process, illustrated in Fig. 5, shows two moistened webs of heavy kraft paper. One side of one web has been coated with a moistureproof adhesive. The two webs are pressed together by rolls and the laminated web is then heated to dry the two paper webs and to complete the cementing together of the webs by heating the moistureproof adhesive. The web is then cooled before being rewound.

The design of this high-temperature heating equipment provides for passing the laminated web exactly between two radiant panels. To avoid destruction of the material when the motion of the web is stopped, insulated barriers (on each side of the web) automatically move upward so as to be interposed between the burners and multi-ply web.

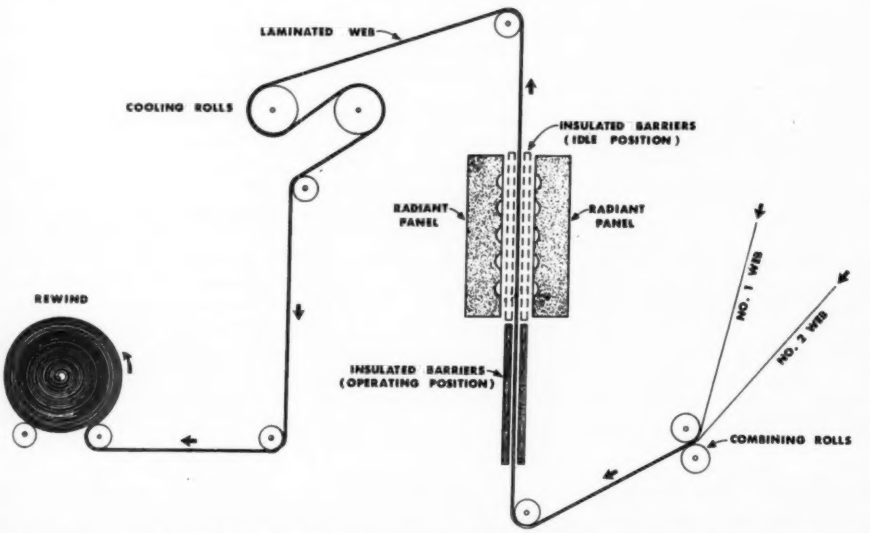


Fig. 5 Diagram showing drying of moistureproof laminated paper by radiant-burner panels

Because combustion of the gaseous fuel is completed within the cup-shaped cavity of the burners, these radiant panels can be placed in close proximity to the web, thereby condensing the size of the eq :ipment and conserving floor space.

Unit Radiant Burners

Some radiant burners are built as separate units in three shapes—round, square, and hexagonal. This permits assembly in an almost endless variety of a-rangements, providing unusual freedom in design.

Used in Bookbinding. One illustration of how this unit-type burner construction has enabled book manufacturers to capitalize on significant savings in floor area, reduction in inventory and labor costs by permitting the conveyerizing of what had been essentially a batch process, is as follows:

One step in the manufacture of books is that of applying adhesive on the backs of the books, before the cover is applied. The next steps are to round the backs and apply the cover, but first, the adhesive which has been applied to hold the book together, must be dried.

After glue has been applied, the books are put on a conveyer which elevates them and carries them horizontally in front of a line of radiant burners located near the ceiling of the room, leaving clear floor space below. The burners direct their radiant heat on the glued backs and dries them rapidly. The conveyer then carries the books before an air-cooling system, and discharges them to the next operator for rounding and covering. This operation requires but a few moments, instead of the former many hours; it also saves rehandling and floor space.

Paper and Paper Products. High-temperature, gas-generated heat also has made it possible for manufacturers of paper and paper products, such as chip board and roofing felt, to realize significant increases in production without any increase in floor area or labor costs.

In the manufacture of these products, large quantities of heat are used in removing the water which is necessarily embodied in the web as an inherent processing step. The conventional method of evaporating this water is to wrap the web over a succession of steam-heated drums, and thus slowly drive out the moisture.

The high concentration of radiant heat, made possible by the complete combustion of the gaseous fuel within the cavity of the radiant burners, enables the burner faces to be located within inches of the wet web, and thus transfer the heat required (to evaporate the water) at a high rate within a concentrated area. Over a half-million Btu per hour may be concentrated per foot width of the web.

Drying Ink in Printing-Press Operation. One of the outstanding examples of heat processing combustible materials by direct flame impingement and by high-temperature radiation, is the drying of printing ink on rotary magazine presses. The success of this application is made possible by the ability to concentrate, direct, and control rigidly the application of high-temperature heat, by the ribbon burner and radiant burner described previously.

The heat-set ink-drying process, with which high-speed rotary presses are now equipped, was developed through co-operative research by the ink manufacturer, the printer, and heat-process engineers. Gas-

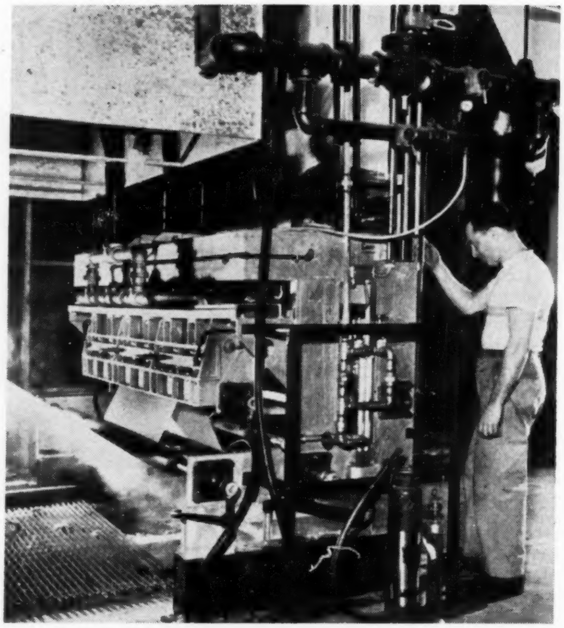


Fig. 6 Dual-burner textile singeing machine in operation

fired driers emit a temperature of upward of 2000 deg F to the paper web, causing almost instantaneous drying of the printed surface and enabling these presses to print up to four colors in daily production at a speed of 1200 fpm.

These modern presses use heat at a rate of over 5,000,000 Btu per hr. The resulting increase in production, conservation in floor space, savings in labor, and the tremendous improvement in over-all economics made possible through heat processing by these burners, have practically revolutionized this branch of the printing industry.

Dual Burner Developed

One development of particular importance in the flame-impingement and high-temperature radiant-heat processing of combustible materials is a dual-type burner which combines the features of the pressurized multiported ribbon burner and the high-temperature radiant burner.

This burner is constructed in the form of an inverted V. The gaseous fuel is fed under pressure to the manifold at the top, and a ribbon flame burns downwardly from the apex of the inverted V and the cavity immediately beneath it. The high-intensity flame burns along the sides of the V causing these "cheeks" to become radiant.

This burner, mounted on a special frame and mechanism designed to move a traveling web of cloth into and out of the V of the burner, constitutes a modern singeing machine. It has enabled the textile industry to quadruple its former rate of production of singed cloth, without any increase in required floor space, and at a greatly reduced saving in labor-handling costs. Equally important is the fact that this combination of flame and radiant heat produces a singed product of a superior quality not matched by methods formerly used.

Fig. 6 shows a singeing machine in operation. The path of the cloth into and out of the burner is readily observed.

The Engineer's *Obligation* to Society

By F. T. Letchfield

Consulting Engineer, San Francisco, Calif. Member ASME

The late Dr. Suzzalo, when President of the University of Washington, once defined a profession as an activity, or calling, the objectives of which transcended the self-interest of the individuals so engaged. He pointed out that the medical profession is seeking to eliminate completely any need for its services; that the pedagogue, whose material remuneration is never commensurate with the time, energy, and money he must expend to equip himself to teach, must find his principal reward in the satisfaction of imparting knowledge, to the end that those so benefited can lead more useful, more constructive lives. The same general considerations characterize all true professions, including engineering.

Truly, here in America, human labor is being reduced in every possible way, in every conceivable direction, and the process of doing so accelerates daily. And for this state of affairs the engineer is largely responsible; nor has he limited his genius to the reduction of human labor as distinct from human skills. Indeed, his greatest contributions may well lie in the new field of automation, for in this the engineer imparts to the machine not only an amplification of human muscle but, in addition, the enlargement, or extreme extension, of the human senses of touch, sight, and memory.

Since the day in 1897 when Thompson discovered the electron, scientists have been adding to their knowledge of the atom, its character and behavior. In doing so, they provided the engineer with the most fabulous tool he has ever had—electronics. To date, he has made excellent use of it but even so, hasn't yet dented the surface of its possibilities. In the meantime, rapid progress in solid-state physics, which already has produced the germanium diode and transistor, will provide compact rugged components which will enable the engineer to make the most complicated operations and processes fully automatic. More than that, it will be possible to perform functions much too complicated, or delicate, for the human senses to achieve.

It is inevitable that this new field, or engineering art, for which we have coined the word "automation," will affect many areas of human endeavor not now directly concerned with the engineer—the accountant, the bank teller, the insurance underwriter, the stockkeeper, train dispatcher, the estimator, and even the draftsman, to name a few. To these will be added thousands of workers in manufacturing plants of all sorts.

Inexorably, automation will eliminate tens of thousands of jobs, good jobs now held by skilled men and women. What will be the effect? Well—despite the forebodings of the unthinking, the labor-union spokesmen, and a certain stripe of demagogues, there will be more jobs—better jobs—but they will require a higher level of training and skills. The social effect will be far-reaching for it will permit further shortening of the work week to thirty-five, thirty, or possibly even twenty-five hours a week. From the economic standpoint, automation is our best hope of still higher standards of living, for the latter is a function of the wealth produced per capita and that is exactly what automation accomplishes. But, while a shorter week and greater wealth are consummations devoutly to be wished for, their acquisition will complicate still further the social and political problems of our time.

Engineering—A Mental Process

Engineering is something far more than the application of scientific knowledge to the perfection of useful things and better processes. Engineering is primarily and essentially a mental process disciplined by the facts involved in any given situation or problem. The lawyer may, at times, successfully make a set of circumstances simulate facts which they are not. The merchant depends greatly upon human emotions in the sale of his wares. Even the physician must take into account the vagaries of human nature in his treatment of each patient. But the engineer—like the scientist—must abide by the facts as he finds them. Moreover, he must give particular regard to the facts which run against him. The aerodynamicist, for example, must start with the laws of gravity, and the mechanical engineer with the realities of friction. But what has all this to do with our society and the engineer's responsibility thereto?

In the first place, the engineer, as the principal contributor to the ease, comfort, and material well being of our citizenry is collaterally responsible for a marked deterioration in the moral fiber, or, to put it more bluntly, the intestinal fortitude of the American public. That statement may be resented—not as engineers but as citizens. Well, let us take a look at the changes in public psychology and attitude which have accompanied high wages, shorter work weeks, more automobiles, electric gadgets, and all the other manifestations of our phenomenal material progress.

Free Enterprise in Jeopardy

In the last analysis, America stands supreme in the world because here and only here have men been truly

Address presented at the San Francisco Professional Division, Fall Conference, San Francisco, Calif., November 12, 1954, of The American Society of Mechanical Engineers. Condensed version of address as presented.

free, free to think, free to speak, free to worship, and free to enterprise to their own benefit. But, twenty-five years ago, as the result of a concatenation of profound economic disturbances and the political effects which followed, we began to compromise the basic principles upon which our forefathers founded our Government. We lacked their faith in the individual and deliberately embraced the oft-discredited belief that Government could, and should, assume responsibility for the economic, social, and moral welfare of its citizens.

The first steps, as they were bound to do, failed to accomplish their avowed end; so, history repeating itself, we journeyed farther and farther into the wasteland of state socialism. So far have we wandered on that trek, that today free enterprise in America is almost a mockery, for our economy is free only to the extent permitted by the Government.

All of this has come about as the result of loose thinking in high places and the deliberate design of those in power politically, but, more particularly, from mass ignorance as to what free enterprise demands of the individual. Or perhaps we might more accurately say the reluctance of so many Americans to exert the self-discipline required to preserve our free-enterprise system.

Ease and luxury have always had a deleterious effect upon those who possessed them. Americans are no exceptions. The extraordinary standard of living we have achieved undeniably has lowered our standards as a people, warped our perspective, dulled our appreciation of the birthrights bequeathed us by the founders of our country, and made it possible for radical groups, teaming with political opportunists, to alter materially our traditional economic, political, and social concepts.

The Engineer's Responsibility

Since the engineer has played such a vital role in providing Americans with the material ease and comforts they enjoy, he must be held responsible, in a large measure, for the unwanted effects our modern way of life has produced. Because he has been trained to think straight, he has the very real responsibility of exerting every influence he can bring to bear to protect and preserve our traditional system of free enterprise.

The current scene in America is one of seeming prosperity, but the world is seething with tensions and facing the possibility that civilization could actually be annihilated. Domestically, both our economy and our social structure are still subject to pressures which would socialize both. The need of the hour for America is straight thinking on the part of its citizens, and the time is past when the engineer can, in any conscience, evade the broader responsibilities of his citizenship. How can he do this? How should he go about it?

It is not a matter of organizing an auxiliary to elect engineers to public office—though the country could well use them at all levels, from the local school boards and planning commissions to cabinet posts. Neither is it necessary nor desirable to set up an organization for political education such as some labor unions and certain radical groups have done. No, the problem for the engineer is the same as for every other citizen. It is an individual one and the course to follow is quite plain.

It is imperative that we understand what free enterprise means, what it entails, how it functions and why; what it requires of the individual, and the political climate it must have if it is to survive.

Recently, President Eisenhower envisioned a national annual income of five-hundred-billion dollars. That is a practical goal but there is no need to place any upward limit upon the wealth America can produce each year. We are only now beginning to see the results of the tremendous strides that have been made in scientific research, in the growth of scientific personnel, development of techniques, and expansion of facilities. Research is growing apace in all fields from nuclear physics and electronics to biology and medicine, including the new techniques of operations research, and other purely economic areas. It would be difficult to overestimate the ultimate results in terms of national wealth and still higher standards of living for the people of America.

It is necessary that each of us become an evangelist in the cause of free enterprise—that we preach its principles at every opportunity to any and all who will listen. This may seem almost puerile, but it is surprising how few people understand what a free-enterprise system actually means.

Self-interest is a legitimate and profound force in all human affairs but, to be beneficial it also must be intelligent. The basis of free enterprise is self-respect and its concomitant, self-reliance. We cannot be self-reliant, we cannot even keep our self-respect if we beseech the Government for help every time an economic difficulty occurs. Yet that is exactly what Americans have been doing for the past twenty-five years. Many of our people do not know any better, but engineers certainly should. Since we have been so largely responsible for softening Americans to hard physical work and have so complicated life in all its present aspects from parking problems to automatic factories, we should be in the van of those straight-thinking members of society upon whose shoulders rests the responsibility of preserving the way of life which has made America great among all the nations of the earth.

Obviously, the task is not one for the engineers alone, but we can make a contribution which, in the end, will be more valuable than that which we have accomplished in respect to the material progress of America. To do so, however, individually and collectively, we shall have to apply the same energy, zeal, and order of intelligence that we have given to our technical activities.

Industry and business managements in America are keenly alive to the potentialities of scientific research—both pure and applied. There is evidence that virtually every component of our economic structure is equally aware of its implications. With such tools available what we have accomplished in the past is no proper measure of what we can achieve in the future.

To convert the fabulous potentials into living realities, we must not only preserve our system of free enterprise but free it of the shackles which today are threatening its existence. To do his part as a citizen in this cause is truly the engineer's responsibility to society.

Railway Passenger-Car Design—

Realistic Goals

New lightweight passenger-train construction, central auxiliary train-line power supply, and effective standardization are the principal ways suggested to put the railroads in a more favorable competitive position to meet today's transportation needs

By T. C. Gray

Vice-President, Engineering
Pullman-Standard Car Manufacturing Company
Chicago, Ill. Member ASME

Rail transport of passengers is and will continue to be a vital and necessary part of our economy. Related problems, many and knotty though they be, are capable of solution. A reasonable measure of success in meeting and solving these problems should produce profitable passenger operation for the railroad industry. Leaving the problem of rates, public relations, services, schedules, etc., to experts in those fields—is there one wherein the car builder figures prominently? This question was well answered in an editorial appearing in *Railway Age* which states in part:

"The basic difficulty in the carriage of passengers by rail today is that it costs too much—for the railroads. Surely the gap is not to be found in 'profits' of the passenger-car builders. People don't consider abandoning a business which provides substantial profits. The real key is that the railroads are trying to fight mass-produced and mass-purchased automobiles and buses—even air transports—with custom-built equipment purchased generally in small lots, and in erratic 'peaks and valleys,' to individual road specifications. The buyers demand weight and strength factors completely out of proportion with other forms of transportation."

The Road to Obsolescence

As of Jan. 1, 1954, only 7.75 per cent of all passenger-train cars owned or leased by Class I railroads and the Pullman Company were between one and five years old, while 62.8 per cent were over 25 years old. The average age of all passenger-train cars was 28.9 years. Obsolescence may well be closely related to the approximate $60 million reduction in coach and the near $14 million reduction in parlor and sleeping-car revenue between 1947 and 1952.

No one is in a better position to appreciate the full significance of the present passenger-car problem than the nation's car builders. To illustrate, a few statistics from Pullman-Standard's postwar experience follow.

Contributed by the Railroad Division and presented at the Annual Meeting, New York, N. Y., November 28–December 3, 1954, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 54—A-49.

Pullman-Standard's Experience

In the period 1945 through 1953, PS built 1235 domestic nonsleeper passenger-train cars from 151 different floor plans for 41 different customers; 43 per cent of these had less than three and 73.5 per cent had less than seven cars per plan. In this same period, PS built 913 domestic sleeping cars, excluding troop sleepers, from 66 different floor plans and for 36 different railroads. Of these, 21 per cent had less than three, and 42.5 per cent less than seven cars per plan. While there are six basic sleeping accommodations, 25 different types were engineered and built. Major detail settlements which permit approximately 200 possible variations, along with further diverse interior-finish schemes, floor plans, and room arrangements, make for near infinite combinations and obviously prevent economic manufacturing processes and effective use of master plans. Unjustifiably high first cost is the end result.

Penalty for Custom Building

The entire car-building industry during the postwar (through 1953) period built 4275 domestic passenger and sleeping cars, excluding troop cars. A very conservative penalty of $12,000 per car, as a result of "custom building" dictated by railroad individual preferences, defines a penalty of more than $50 million in first cost alone—and this is just the beginning.

Use of special, inconsistent designs and items of equipment has cost the railroads many more dollars in expanded inventory, added maintenance, and alteration work to correct service-produced difficulties not previously anticipated. With the foregoing in mind, one wonders how the railroad can afford to purchase, how the builder can afford to build, and how the vendor can afford to participate in such a highly customized program.

Standardization—A Partial Solution

In 1948 a number of railroad presidents indicated their interest in standardization. The American Railway Car Institute has taken active interest in this very worth-

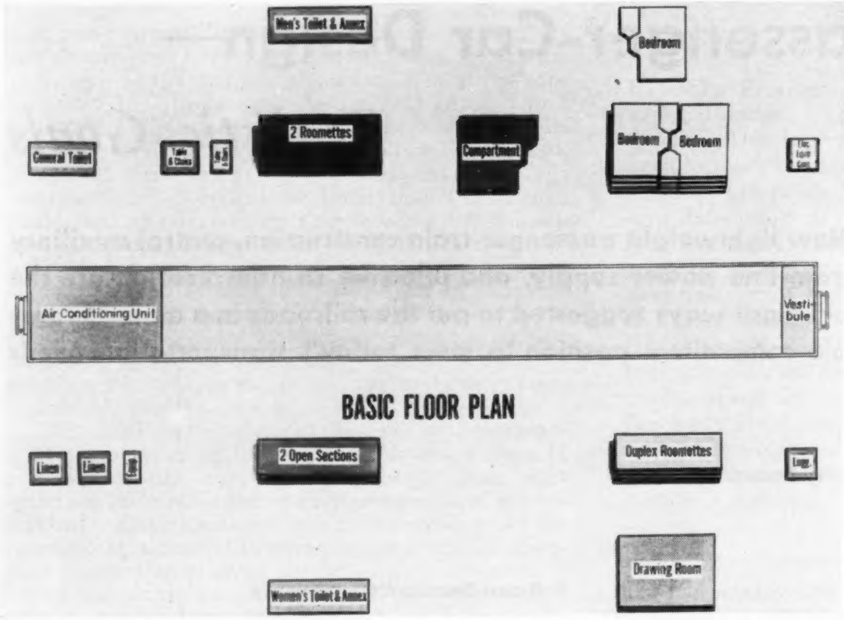


Fig. 1 Basic plan outline of railway passenger car showing air-conditioning and vestibule locations. Arranged around it are pre-engineered modules or units.

while project and has made considerable "paper" progress.

Nineteen floor plans, which covered all types of nonsleeping cars, were approved by the AAR in 1950. In 1952 agreement was reached on six basic sleeping-car plans which will shortly be resubmitted to the AAR for final action.

Even with the conventional type of passenger car, definite and substantial savings can be effected in first as well as maintenance and operating costs if the railroads will consider seriously the studied recommendations of the car builders and the ARCI.

While standardization of conventional equipment to the extent that it is actually accepted will certainly reduce the cost thereof, weight and cost per seat will still remain relatively high. Much greater potential gain lies in the concept of complete train redesign, later discussed, wherein these ratios are to be greatly improved. While admittedly involving principles at variance with conventional attitudes, there can be no doubt that ultimate salvation lies only in this approach.

The "Module" Principle

In addition to taking active part in the afore-mentioned ARCI standardization program, Pullman-Standard is designing on the module principle to allow flexibility in plan arrangement. Basic sleeping rooms are engineered as units together with electric lockers, general toilets, air-conditioning installations, linen-equipment lockers, etc. Six basic floor plans are available into which these individual units may be so arranged as to meet railroad requirements. Component interchangeability between primary assemblies to help simplify customer inventory is also appreciated.

Fig. 1 shows the basic plan outline of the air conditioning and vestibule locations. Arranged around it are the pre-engineered modules or units. Figs. 2 to 4 show some of the many possible arrangements of these modules into acceptable plans.

Design for Lighter Weight

A modern conventional coach weight closely approaches one ton per passenger with an approxi-

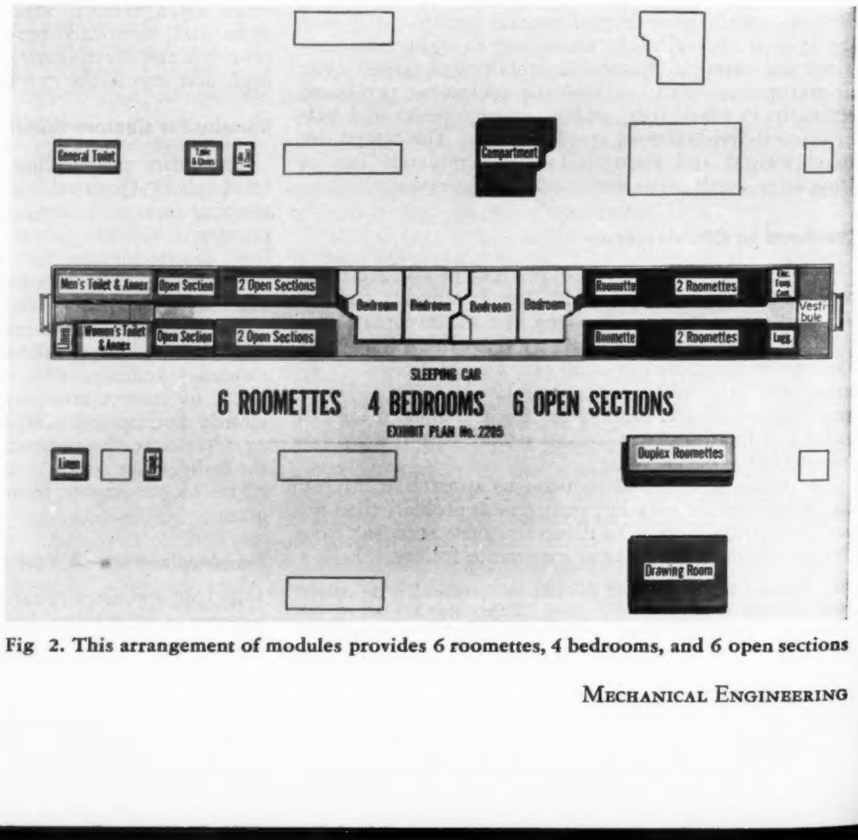


Fig 2. This arrangement of modules provides 6 roomettes, 4 bedrooms, and 6 open sections

mate cost of $2000 per passenger. Transcontinental coaches and sleeping cars plus the locomotive, in a luxury-type train, when averaged with other needed cars in the consist, may more than double these figures.

It would appear that weight and cost ratios should be brought more in line with that of automobile, bus, and airplane competitors if railway-passenger business is to survive.

There are always problems to be solved when new and divergent designs are adopted, but these can be overcome if the desire for progress is real and compelling.

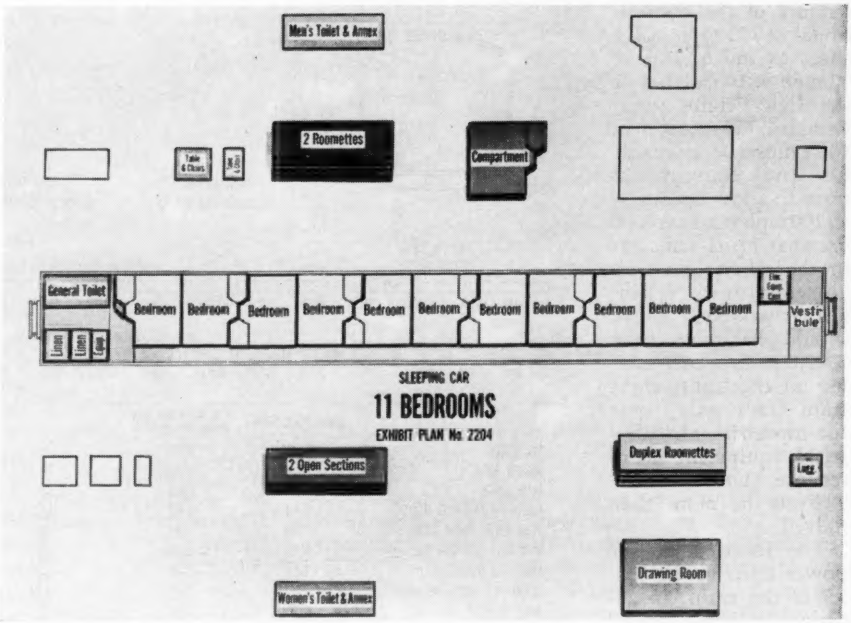


Fig. 4 This 11-bedroom passenger car shows another of the many possible arrangements with the module principle

Central Auxiliary Power

With respect to reduction in weight and cost of conventional cars, great potential return lies in the use of central auxiliary power.

Differences in electrical systems in use on the railroads not only affect initial operating and maintenance costs but represent a most effective barrier to standardization and easy interchange of passenger cars between roads. A standard electrical system is required which is economical to buy, install, and operate—equipment that is produced in large quantities for widespread use in industry, is economical to operate, and offers little installation difficulty.

The most economical and desirable central source of electric power for a train would be a generator voltage of 440 volts, three-phase, 60-cycle. This power source would occupy a portion of a car with the remaining portion of the car used as dormitory, kitchen, baggage, baggage-mail, coach, etc. The car would be centrally located in a train with the auxiliary plant feeding power both fore and aft. Each power car would carry two 440-kw diesel-driven alternators if heating is included.

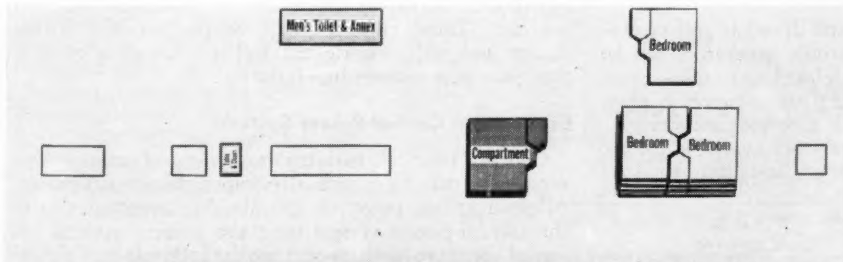


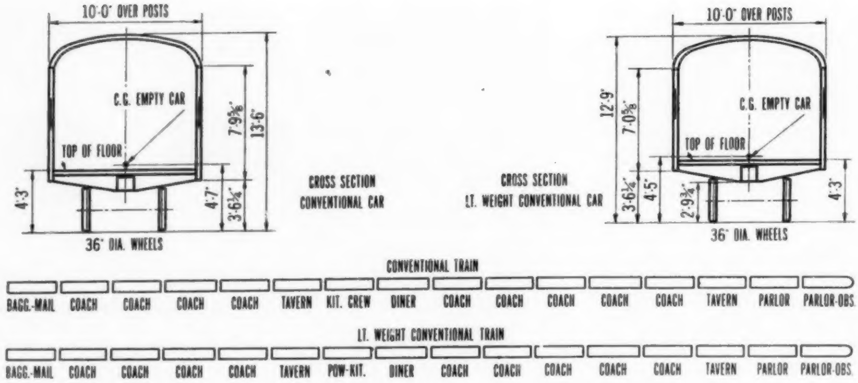
Fig. 3 Another sleeping-car arrangement by the modular method results in 20 roomettes

Fig. 5 graphically portrays the electrical equipment which is normal to a conventional 64-volt car but which could be eliminated with the central auxiliary power system—a net saving in weight of electrical equipment per train of 49.7 tons.

It is of interest to compare a conventional 16-coach luxury train with one having the same consist, but using a central auxiliary power car and with lighter 85-ft-length car as shown in Fig. 6. A saving in train weight of 172 tons is possible. Weight per passenger has decreased 620 lb. Train re-

sistance of the conventional at 100 mph is 1.3 times as much, and at 50 mph is twice that of the lightweight train. Drawbar horsepower of 5000 must be available for the conventional train to allow operation to 100 mph whereas 4000 drawbar hp is sufficient for the lightweight near-conventional train. Conservatively, there should be more than $300,000 first-cost saving on the lightweight train (cars only) over the conventional. Electrical equipment maintenance should conservatively be more than halved.

The location of the power units in the center of the train, in addition to being placed more efficiently for transmission and train-line size, permits the use of conventional cars in centrally powered trains. Conventional equipment can be used in front of those cars fed from the power units. When cars are interjected ahead of the central-powered cars, axle-powered head-end cars could be used. Also, individually powered cars can be used anywhere in the train by the simple expedient of providing a through train line and coupler heads.



	CONVENTIONAL TRAIN	LT. WT. CONVENTIONAL TRAIN CENTRAL AUXILIARY POWER
CAR LENGTH	85'-0"	85'-0"
COUPLER HEIGHT	2'-10½"	2'-10½"
TRAIN LENGTH	1360'	1360'
LENGTH PER PASSENGER (FEET)	2.48'	2.48'
TRAIN WEIGHT LOADED (TONS)	1188	1016
WEIGHT PER PASSENGER (LBS.)	4160	3540
NUMBER OF PASSENGERS	548	548
HEIGHT—C.G. ABOVE RAIL (INCHES)	55"	53"
WHEEL DIAMETER	36"	36"
HEIGHT OF FLOOR	4'-3"	4'-3"
OVERALL HEIGHT OF CAR	13'-6"	12'-9"
NUMBER OF AXLES	64	64
WIDTH OVER POSTS	10'-0"	10'-0"

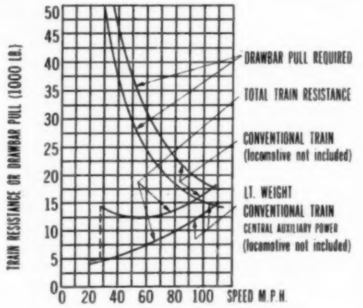


Fig. 6 Comparison of a conventional passenger train with a lightweight conventional train

The effect on train resistance and drawbar pull of producing electric power by axle-driven generators can be clearly seen by referring to the related resistance curves in Fig. 6. The difference between these curves is practically all due to resistance of the generator and drive.

With the new static-type regulators available for a-c systems, providing instantaneous response to load changes, voltage regulation on the central-powered train will be much improved over the d-c systems. This improved regulation will improve both the quality and life of a lighting installation. Each car is equipped with a small battery to provide sufficient emergency lighting to allow for movement of passengers through the car. These batteries will be on constant trickle charge and will operate the lights through a relay if there is a power-train line failure.

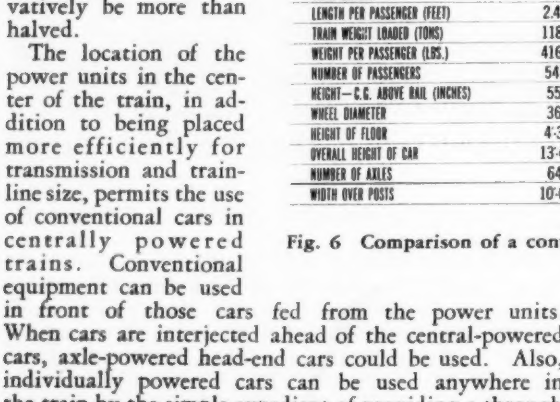


Fig. 5 Equipment and weight eliminated from conventional axle-powered car (64-volt system) by the use of central auxiliary power—electrical system only

Economy in Central-Power System

General over-all maintenance costs of one system versus the other are virtually impossible to determine. All indications point to considerable economies with the central-power system over the present system. A few of the more obvious ones are the following: (*a*) One main power source to service and inspect; (*b*) power source located in a protected enclosure; (*c*) lower inventories of spare parts; (*d*) lower replacement costs; (*e*) elimination of large storage batteries; (*f*) the use of electric heat could obviate the steam generators, steam lines, connectors, regulators, and valves; (*g*) sealed unit compressors; (*h*) brushless motors with sealed pre-greased bearings; and (*i*) no power-conversion units for fluorescent lighting, radio, or entertainment systems.

Conservatively, at least 50 per cent saving over the present maintenance cost could be realized.

"Train X"

As previously mentioned, the author believes that the ultimate solution lies only in complete train redesign. This design approach is typified by Train X wherein

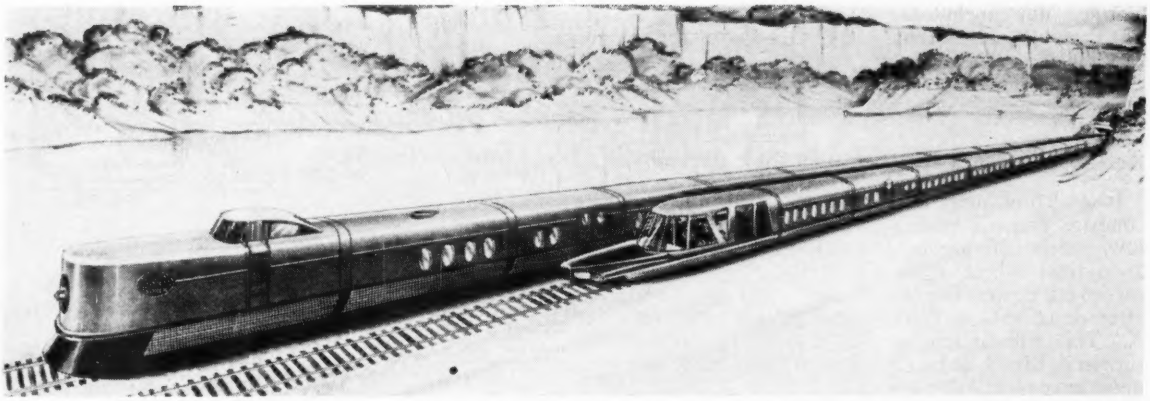


Fig. 7 Train X, wherein design concepts of power units (propulsion, auxiliary) and cars differ greatly from conventional

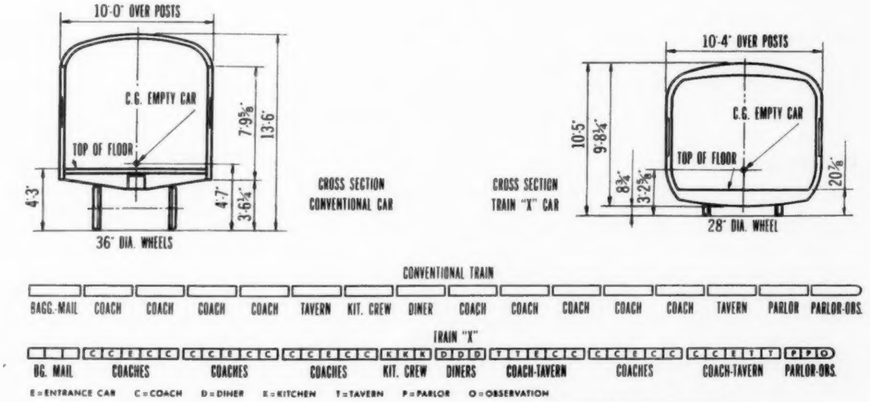
the design concept of power units (propulsion and auxiliary) and cars differs greatly from conventional.

Train X, Fig. 7, was fostered by K. A. Browne, director of research of the Chesapeake & Ohio Railroad. Pullman-Standard collaborated in research and development, and in 1950 produced a prototype car. One experimental passenger car, a transition car, and an observation-car mock-up were built. Extensive tests have been conducted by both Pullman Standard and the Chesapeake & Ohio Railroad with speeds to 105 mph and with superior riding conditions.

Aluminum-superstructure cars are of the steered single-axle-in-rear type, with front end of each car supported by the car ahead except when uncoupled. When uncoupled, the front end is supported by retractable dolly wheels which can be lowered for switching and backing. Head-end auxiliary power is provided. Automatic couplers have been developed. Train X will meet all AAR requirements. Center of gravity is approximately 1 ft 6 in. lower than the conventional car. Fresh air at 300 cfm is provided through a roof inlet. Each car has a fresh-air blower and a circulating blower. General illumination is by fluorescent tubes. Suspension is provided with air spring with torsilastic stabilizers. A self-leveling-type valve maintains constant floor height irrespective of load.

Train X Vs. Conventional

Fig. 8 is a comparison of two coach trains. Both have luxury accommodations and are essentially of the same floor space and accommodations with respect to comfort. The conventional train has 16 modern air-conditioned cars with stainless-steel superstructure and high-tensile low-alloy-steel underframes. Four-wheel trucks are provided. Train X cars are as previously described. Related resistance-speed and drawbar horsepower-speed curves are shown with resistance as computed by a modified Davis formula. Cars were considered to be units of 93 ft, $7^1/_2$ in. in length with three axles, and weights shown are high. All curves are for level tangent track operation and with fully loaded trains. Resistance shown is that for the total train only (loco-



	CONVENTIONAL TRAIN	TRAIN "X"
CAR LENGTH	85'-0"	31'-2½"
COUPLER HEIGHT	2'-10½"	13½"
TRAIN LENGTH	1360'	1311'
LENGTH PER PASSENGER (FEET)	2.48'	2.22'
TRAIN WEIGHT LOADED (TONS)	1188	512
WEIGHT PER PASSENGER (LBS.)	4160	1566
NUMBER OF PASSENGERS	548	588
HEIGHT—C.G. ABOVE RAIL (INCHES)	55"	38⅝"
WHEEL DIAMETER	36"	28"
HEIGHT OF FLOOR	4'-3"	20⅞"
OVERALL HEIGHT OF CAR	13'-6"	10'-5"
NUMBER OF AXLES	64	42
WIDTH OVER POSTS	10'-0"	10'-4"

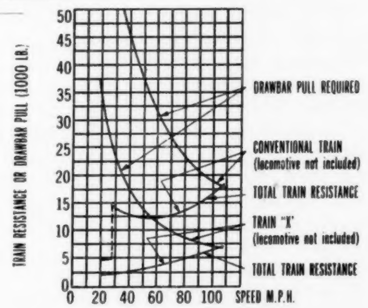
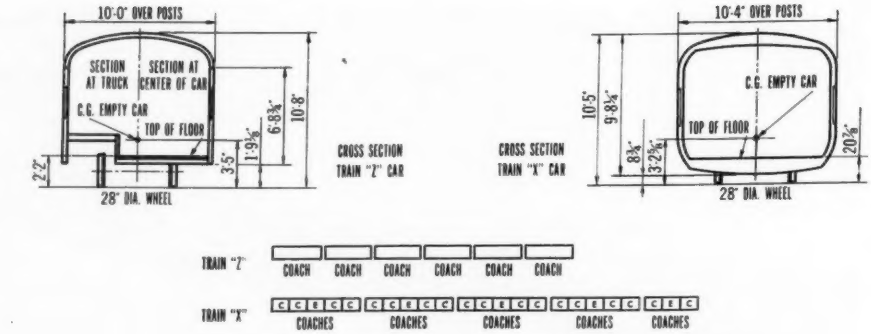


Fig. 8 Comparison of a Train X passenger coach with a conventional-type passenger coach

motive not included). The drawbar pull is that required for train operation to 100 mph balancing speed.

Train X Vs. Train Z

It is also of interest to compare Train X with a low center of gravity, 28-in-diam wheel, 85-ft-car-length train as hereinafter described as Train Z. This comparison, as shown in Fig. 9, is based upon near-identical train weights (cars only). Train Z utilizes some of the desirable features of Train X. However, two four-wheel trucks modified to obtain maximum benefit from the lower center of gravity are used. The conventional center-sill construction has been eliminated and replaced with suitable side structural members. Wheel wells are provided above the trucks thus allowing the low 41-in. center-of-gravity height above rail. Couplers, draft gear, and such appliances would be conventional but designed for the lower-weight car. New propulsion power would be required with auxiliary front-end power on short trains, and with central auxiliary power on trains with more than eight cars. Alternating current, 440-volt 3-phase, would be proposed for all loading such as air conditioning, heating, lighting, etc.



	TRAIN "Z"	TRAIN "X" *
CAR LENGTH	85'-0"	31'-2½"
COUPLER HEIGHT	16"	13½"
TRAIN LENGTH	510'	718'
LENGTH PER PASSENGER (FEET)	1.12'	1.42'
TRAIN WEIGHT LOADED (TONS)	263	267
WEIGHT PER PASSENGER (LBS.)	978	885
NUMBER OF PASSENGERS	456	504
HEIGHT—C.G. ABOVE RAIL (INCHES)	41"	38⅝"
WHEEL DIAMETER	28"	28"
HEIGHT OF FLOOR	2'-2"	20⅞"
OVERALL HEIGHT OF CAR	10'-8"	10'-5"
NUMBER OF AXLES	24	23
WIDTH OVER POSTS	10'-0"	10'-4"

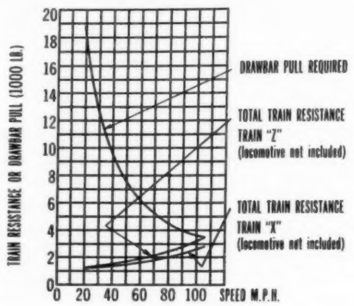


Fig. 9 Comparison of a Train X car with a Train Z car, a low center-of-gravity, 28-in-diam wheel, 85-ft car-length train

Conclusion

Today's conventional propulsion and trailing equipment represents an investment of millions of dollars and it will not soon be scrapped in wholesale lots. Some new cars of this design will be needed. Such cars can be made much less costly to purchase, operate, and maintain if standardization is made the byword.

Present electrical systems probably offer the most immediate and fertile field for a program of standardization. Replacing the many divergent and costly systems with central auxiliary power is entirely within reason and the potential economic benefits make serious consideration well justified.

Just as some 20 years ago the then new streamlined trains established a design concept that was to hold until the present day, recent developments make it clear that another, and probably more radical, period of evolution has been entered. From this should ultimately emerge a vastly superior product, more competitive with other means of transportation, and far less costly to own, operate, and maintain than conventional equipment. Because they are typical of this new era, and because of the principles involved, Train X and Train Z have been discussed briefly. Design along these or similar lines should permit gains without the necessity for huge expenditures to change existing roadbeds. It must be borne in mind, however, that interchangeability with existing equipment cannot be considered for maximum operating results. Also, the ultimate savings with cars such as Train X cannot be realized by using power as now designed and built for conventional cars. The relatively high-center-of-gravity and large-cross-section locomotive will not allow the desired schedule improvements offered by such trailing cars.

Whether individual railroads shall seek to revitalize passenger operations through use of much improved conventional equipment, by conversion to cars and locomotives of greatly reduced cost, or through a combination of the two approaches is, of course, a decision which can be made only by their respective managements. The builders can be of service in presenting suggestions backed by sound engineering and economic studies, and by standing ready to build the kind of equipment best-suited for the service in question.

The builders and those who provide special car equipment can be of further service by working to improve their products. The builder must build better and more trouble-free cars to allow higher availability and utilization and greatly reduced maintenance. It would be most helpful to the builder and to the railroad to have equipment interchangeable with respect to application. It is essential to get away from the highly complex "job-shop" approach with customized equipment and utilize mass-produced "off-the-shelf," well-proved, and trouble-free commercial items.

It is believed that with the potential improvements that can be made in the railway-passenger field by an all-out effort on the part of the railroads, builders, and vendors, the railroads could soon regain their leadership in this vital and necessary part of our economy.

Evaluating Shock Mounts

"Standard" Shock Motions, Shock Spectra, and Typical Shock-Mount Tests on Navy Test Equipment Are Described

By J. P. Walsh[1] and R. E. Blake

Mechanics Division, Naval Research Laboratory, Washington, D. C.

SHOCK mounts are flexible couplings used to attach equipments to structures which may be subjected to shock motions. They generally are much stiffer than vibration isolators. The greater stiffness is required because clearances for the equipments are not available for the large displacements which would result if the more flexible system were used. Therefore the shock mounts will aggravate much of the lower-frequency components of the steady-state vibrations and of the shock motions.

At present the principal criterion as to whether or not a shock mount is satisfactory for military use is that the equipment it supports withstand specified "shock" tests.

The objective of this work is to devise a procedure for determining those shock-mount characteristics which would (*a*) permit the evaluation of the relative effectiveness of different types of mounts, (*b*) provide a means of defining when a mount is acceptable, and (*c*) provide information useful to the designer of equipments to be supported by the mounts. This paper describes the methods developed with these objectives in view and presents some results for a few typical shock mounts.

Criterion of Performance

A shock mount should be judged by its ability to protect an equipment from shock damage. It may be evaluated relative to a rigid support system, or in comparison with the effectiveness of other mounts. Two difficulties are immediately apparent if no limitations are placed on the nature of the equipment and on the nature and intensity of the shock motions:

1 The probability of damage to an equipment is greatly dependent on whether elements in the equipment might be strongly excited by frequency components passed, or introduced, by the mounting arrangement. These particular frequency components may have very little potential for damaging other equipment having differential natural frequencies of vibration. It will, therefore, be necessary to employ an idealized type of equipment for determining the effectiveness of a mount.

This equipment, shown in Fig. 1, is assumed to be rigid and contains a large number of single-degree-of-freedom systems which represent vulnerable parts of the equipment. The natural frequencies of these simple systems collectively cover the frequency spectrum of interest. All motion is along one axis and the masses of the elements are assumed to be sufficiently small as not to affect the motion of the equipment. The elastic stress which each of these elements must be able to withstand without failure is assumed to be proportional to the maximum force that acts on the mass of the element considered. This maximum force is proportional to the maximum deflection of the spring of the element, and to the maximum acceleration of the mass. Values of acceleration generally will be different for different elements and, of course, will be different from the ac-

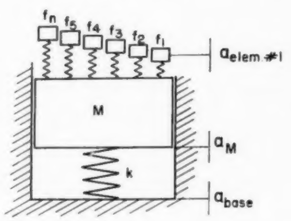


Fig. 1 Rigid equipment *M*, shock-mounted by spring *k*, and containing elements having natural frequencies f_1 through f_n. Accelerations of parts are denoted by *a* with suitable subscripts.

celeration experienced by either the equipment or the mount. A quantitative expression for the effectiveness of a mount, for a given shock motion, is then expressed in terms of the accelerations experienced by these elements. The effectiveness is a specific value for each different element and is represented as a curve, Fig. 6 or 9, where the ordinate represents a measure of effectiveness and the abscissa represents the natural frequencies of the elements.

It is customary[2] to plot the maximum acceleration experienced by the element masses as this measure of effectiveness. This curve is frequently called the "shock spectrum" and the values are ordinarily labeled "equivalent static acceleration."

2 Whether one shock mount may be judged better than another mount depends upon the nature and intensity of the shock motion. It is, therefore, necessary to standardize on one or more types of shock motion and to use these consistently when comparisons are made.

The Navy logically would standardize on shock motions such as may occur on board ship. However, they vary from ship to ship and from one location to another on the same ship. But the shock motion delivered by the Navy shock machines is, in a sense, a standard shock. It is used to determine the suitability of equipment for naval use.

[1] Head, Isolation Devices Sub. Sec., Sound Division. Assoc. Mem. ASME.

Contributed by the Rubber and Plastics Division and presented at the Annual Meeting, New York, N. Y., November 28–December 3, 1954, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[2] "The Equivalent Static Accelerations of Shock Motions," by J. P. Walsh and R. E. Blake, Proceedings of the Society for Experimental Stress Analysis, vol. 6, 1949, pp. 150–158.

Although of interest and importance, the practical validity of the motions of shock machines does not affect the present investigation. This procedure has the advantage of flexibility. If the shock machines should be changed or modified, it would follow that the mounts would be examined on the modified machines.

Other types of tests were performed to determine the static and dynamic physical properties of shock isolators. These include the determination of (*a*) static load-deflection curves, (*b*) dynamic load-deflection curves and energy loss by impact tests, and (*c*) dynamic elastic modulus by vibration tests.

Description of Impact Test Apparatus

A hammer weighing either 100 or 175 lb was dropped between guides so as to strike the central section of a

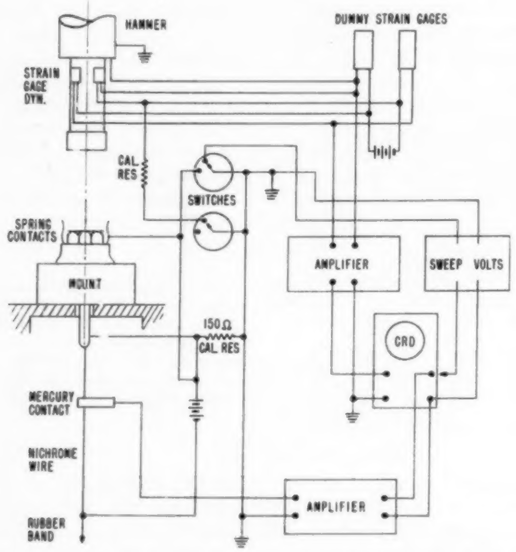


Fig. 2 Schematic diagram of equipment for hammer-drop test

shock mount. Strain gages attached to a cylindrical element between the hammer striking surface and the main body of the hammer allowed force measurements to be made. A resistance wire was attached at one end to the central section of the mount and was kept taut by a rubber band at its opposite end. The wire passed through a fixed-position mercury contact, which allowed the displacement across the mount to be determined. The schematic diagram, Fig. 2, illustrates the principle of this test. Curves of dynamic force versus deflection, or versus time, were recorded oscillographically by this equipment.

Mount Test on Lightweight Shock Machine

A description of the Navy light and medium-weight shock machines is given elsewhere.[3] Fig. 3(*a*) is a schematic diagram of the lightweight shock-mount test apparatus. Figs. 3 (*b* and *c*) are photographs of the actual apparatus. On the diagram, (1) is the shock-machine hammer which strikes the anvil plate (2); (3) and (4) represent the spacers and $^1/_2$-in. mounting plate shown in Fig. 4.[4] These items are parts of the standard machine. The mounting plate stiffeners (5) will be described later. A rod-crosshead system (6) is used to provide linear motion at the base of the mount (8) under test. The load on the mount (10) consists of a special reed gage and enough auxiliary weights to reach the desired mass. The range of loads available is 20 to 75 lb. The load is constrained to straight-line motion by tracks and rollers (11). Between the load (10) and the mount (8) is a dynamometer (9). This is a short column to which SR-4 wire strain gages have been attached. A slide-wire displacement gage (12) is integral with the reed gage (10). The velocity meter (13) measures the velocity at the base of the mount. Two of the elements of this apparatus (the mounting-plate stiffeners and the reed gage) require further explanation.

Different transient frequencies in the shock motion are obtained by varying the stiffness of the plate. This is done by using three different bolting arrangements to fasten stiffening channels to the plate. These are (1) two bolts spaced 2 in. on either side of the vertical center line, (2) the first two bolts plus two more spaced 6 in. on either side of the center line, and (3) these four bolts plus two additional bolts spaced 12 in. on either side of the center line. These last bolts are at the channels supporting the plate from the anvil plate. This variable stiffness provides three essentially different shock motions.

The reed gage, which forms part of the test load on the mount, approximates a group of single-degree-of-freedom systems. The maximum deflections of the reeds are recorded on waxed paper by the scribers attached to the tips of the reeds. From these deflections the shock spectrum of the motion of the load can be computed by the method described previously.[1] It should be noticed that this load is extremely rigid compared with most equipments. The effect of this unusually high rigidity on the results is discussed later.

Mount Test on Medium-Weight Shock Machine

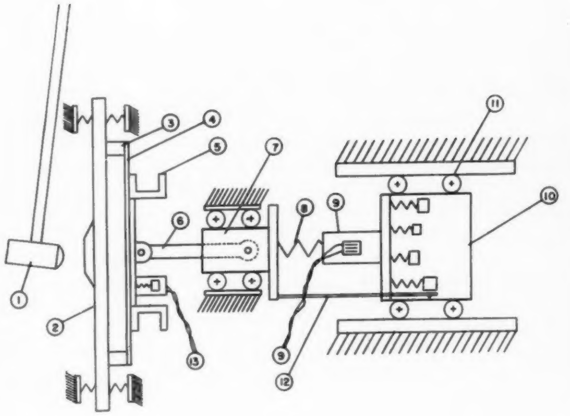
In the case of the lightweight machine it was convenient to design the apparatus on the basis of testing one mount at a time, but the arrangement of the medium-weight machine makes it more convenient to use four mounts to support the test load. Actually, only one mount is instrumented completely; that is, one of the spool-shaped pieces connecting the mount to the load has strain gages attached and the slide-wire displacement gage is located as close as possible to it.

Fig. 4(*a*) is a schematic diagram of the test apparatus used with the medium-weight shock machine. Fig. 4(*b*) is a photograph of the apparatus and test mount on the shock machine. The essentials of this apparatus are identical with the lightweight machine apparatus, and that discussion will apply except for the method of obtaining different stiffnesses of the mounting adapter.

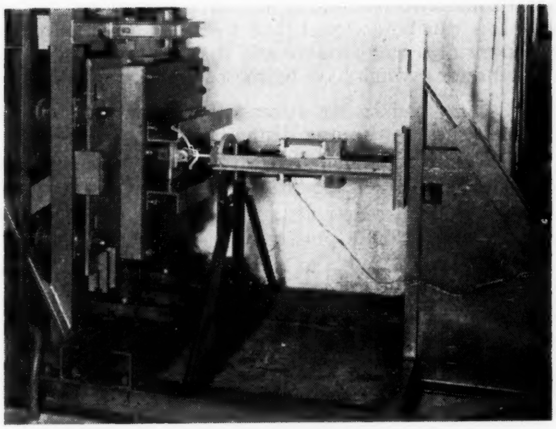
For the purpose at hand it is required that the vibrations at the base of the mount be controlled enough to insure that if a frequency coincidence should exist during one test it would not exist on other tests of the same investigation. Since the load platform of the test ap-

[3] "Some Characteristics of Navy 'High Impact' Type Shock Machine," by I. Vigness, Proceedings of the Society for Experimental Stress Analysis, vol. 5, 1947, pp. 101–110.

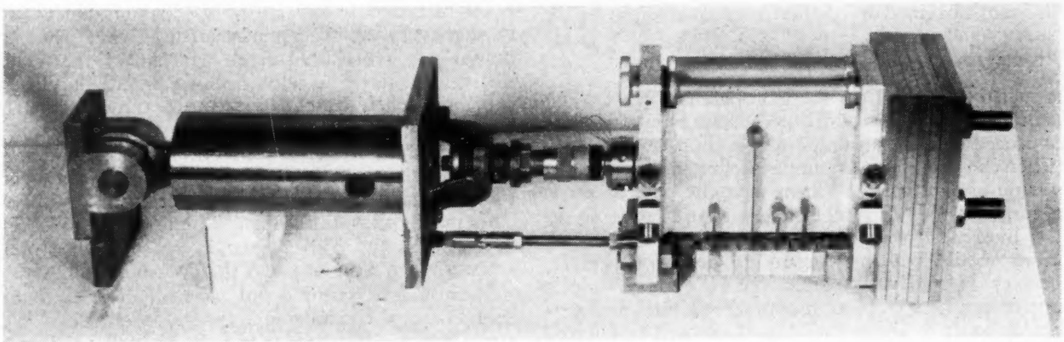
[4] "Interim Military Specification Tests; Shock, Vibration and Inclination," MIL-T-17113 (Ships), July 25, 1952, BuShips, Navy Department, Washington 25, D. C.



(*a*)

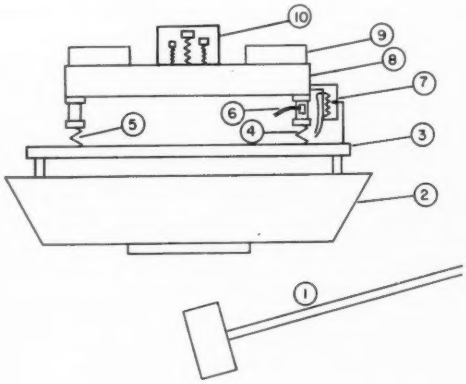


(*b*)



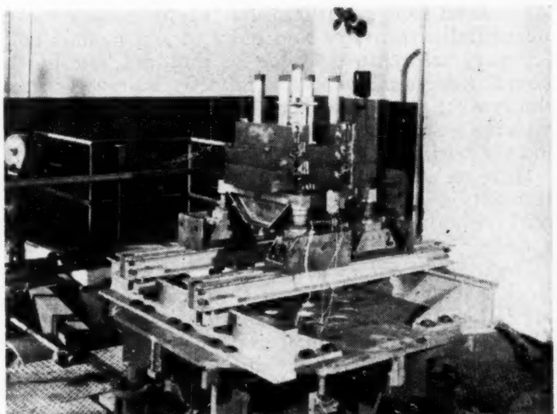
(*c*)

Fig. 3 (*a*) Schematic diagram of test arrangement on lightweight shock machine. (*b*) Photograph of setup equivalent to (*a*). (*c*) Photograph of mount and idealized equipment.



(1) hammer
(2) anvil table
(3) mounting channels
(4) test shock mount
(5) auxiliary shock mounts identical with (4)
(6) calibrated dynamometer
(7) slide wire and maximum displacement gage
(8) load platform
(9) auxiliary weights
(10) reed gage

(*a*)



(*b*)

Fig. 4 (*Left and above*) (*a*) Schematic diagram of test arrangement on medium-weight shock machine. (*b*) Photograph of setup equivalent to (*a*).

paratus has two possible center distances—16 in. and 24 in.—this can be accomplished by selecting three combinations of center distance and channel supports. The combinations which have been used are the following:

(*a*) Test-load center distance = 16 in., supporting channels for 24-in. center distance.

(*b*) Test-load center distance = 24 in., channels for 24-in. center distance.

(*c*) Test-load center distance = 24 in., channels for 24-in. center distance plus two car-building channels.

The instrumentation required for the tests on the lightweight and medium-weight shock machines is similar to that of the hammer-drop test. The force transmitted by a mount was determined from strain measurements on elements of known stiffness. Displacements were measured by means of a slide-wire potentiometer arrangement. A velocity pickup indicated the motion of the shock machine, and a reed gage provided a shock spectrum of the equipment motion. Except for the reed gage, which was self-recording, all records were obtained by cathode-ray oscillographs.

Test Procedure

The method of taking data is apparent from the instrumentation but a few additional remarks are in order on the procedure of running a test of a shock mount.

Neither the directions of mount deflection nor mount orientation aboard ship are known at the time a test is being run, so one must consider all directions to be equally likely. However, to test a mount in many directions would be time-consuming and, fortunately, unnecessary. Usually, two directions are enough—along the axis of symmetry (most mounts have one) and perpendicular to it. These two directions will be referred to as axial and radial.

Hammer-drop and the lightweight machine tests have been designed to insure uniaxial deflection of the test mount. To test in the radial direction, a right-angle bracket is made and attached to the base of the crosshead. The mount is attached to the bracket so the motion of the load produces radial deflections of the mount.

The anvil table of the medium-weight machine moves substantially vertically. In order to test mounts radially they are rotated 90 deg so that the base of the mount, horizontal on the axial test, is now vertical. Brackets are made to secure the mount in this position with the base attached to the vertical leg of the bracket and the horizontal leg to the supporting channel.

There are cases when it appears to be of interest to conduct tests in which the direction of deflection is neither axial nor radial. In these cases special brackets are designed.

The independent variable in a test of a mount on the shock machines is the height through which the hammer falls before striking the anvil plate. Test runs are made using different stiffnesses of the mounting adapter with the height of hammer drop held constant. Each run with a given adapter stiffness produces a shock spectrum. These are averaged and the resulting spectrum, called the "averaged" or "composite" spectrum, is used to judge the mount.

Results

In the course of developing this method of determining the characteristics of shock mounts several shock-mount designs have been studied. A few selected samples of the data (on five of these mounts, called mounts O, A, B, C, and D) obtained using the hammer-drop tests and the lightweight shock machine apparatus are presented here purely for the purpose of illustration.

Fig. 5 illustrates dynamic and static force-deflection curves for mount O obtained by the hammer-drop tests and on a Baldwin-Southwark Universal tester, respectively. The mount was caused to deflect at a rate of 0.15 ipm for the static tests. The time for the completion of the dynamic cycle was in the order of 0.02 sec. The straight line represents the stiffness of the mount as determined from the value of the resonant frequency when the mount was supporting a known mass. This frequency was about 35 cycles per sec (cps) and the amplitude of vibration was about 0.1 in. The rubber in this mount was especially compounded for high energy absorption.

Fig. 6 shows the averaged spectra for the four shock mounts subjected to 3-ft hammer drops on the lightweight shock machine. The deflections were in the axial direction. The shock spectrum labeled "rigid" is the averaged spectrum resulting when the "shock mount" is a block of steel. It shows the values of equivalent static acceleration to which equipment is subjected when attached rigidly to the shock machine. This figure shows that different mounts provided different degrees of shock protection. It should be noted that the spectrum from mount A crosses the spectrum for the rigid mounting at approximately 350 cps. This means that any system having a natural frequency between 50 and 350 cps would be subjected to higher stresses when mounted on A than when no mount is used.

It should be pointed out that all of the mounts except D are of conventional types. Mount D is a metal strap which yields under the shock load; the energy is dissipated in the plastic deformation of the metal and is not available for subsequent vibration of the load. After the shock, the load does not necessarily return to its initial position—a characteristic regarded as unacceptable. This mount has been included in these studies because it produces the lowest shock spectrum of any mount tested.

The axial shock-load-deflection curves for mounts A, B, C, and D are shown in Fig. 6. These curves are useful in interpreting the shock spectra of Fig. 7. Mount D produced the lowest shock spectrum; the peak force was the smallest; the energy dissipated in the cycle (the area of the loop) was the greatest. Mount C produced a low shock spectrum because it remained practically linear during the loading cycle. Mounts A and B were extremely nonlinear and exerted high peak force on the load. These load-deflection curves show that both mounts A and B were overloaded. The load on mount A was 25 lb (the manufacturer's rating) but if this load had been, say, 10 lb, the load-deflection curve probably would have remained more linear.

Mount B, rated for a load of 50 lb, was tested with a load of 25 lb, which was too great for the mount. Mount C, which had a 35-lb load, was capable of absorbing the required amount of energy without "bottoming." Relatively low forces were applied to the load and a low shock spectrum resulted. The shock spectrum of mount A attains the highest magnitude of those shown, and the peak force transmitted by the mount is the greatest, reaching a value of 9000 lb. The maximum stiffness attained by mount A was about 120,000 lb per in.

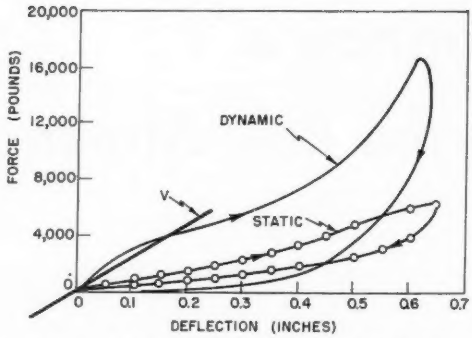


Fig. 5 Characteristics of mount O. Dynamic deflections were obtained from the hammer-drop test. Slope of *V* was determined by resonance-vibration tests.

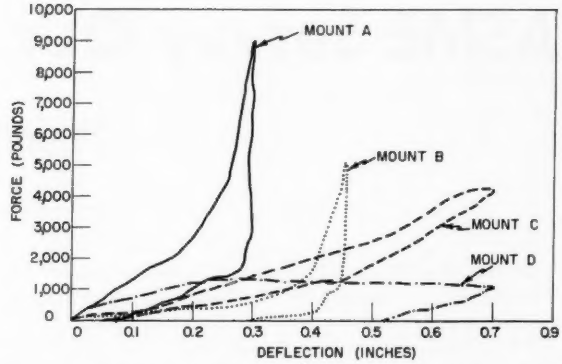
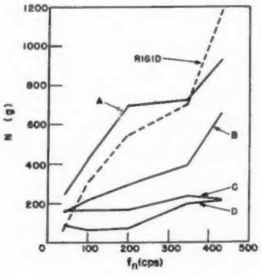


Fig. 7 Axial load-deflection curves for shocks delivered by lightweight shock machine

Fig. 6 Comparison of averaged shock spectra for an equipment rigidly supported, or supported by shock mounts A, B, C, or D. Deflections of mounts were axial.



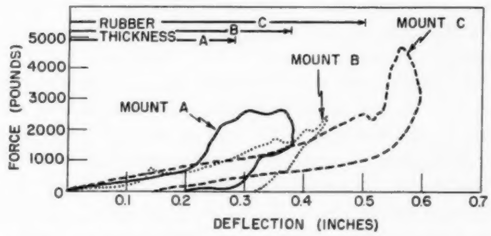
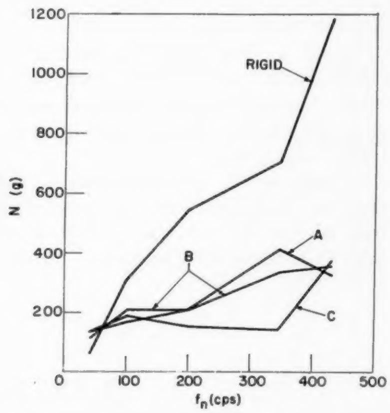


Fig. 8 Radial load-deflection curves for shocks delivered by medium-weight shock machine

The load-deflection curves for the mounts deflected in the radial direction are shown in Fig. 8.

The averaged shock spectra of mounts A and B for radial deflections, Fig. 9, are lower than those for the same mounts in the axial direction. This is to be expected after studying the load-deflection curves.

Fig. 9 Averaged shock spectra for radial deflections of mounts A, B, and C



Summary and Conclusions

It is assumed that the probability of damage to an element of an equipment that is subjected to a shock motion increases in some manner with the maximum force experienced by that element. An idealized type of equipment was constructed which consisted of a rigid mass on which were attached a large number of single-degree-of-freedom elements. Each of these elements had a different natural frequency and together they covered the frequency spectrum of interest. This equipment was attached to one side of a shock mount; the other side of the mount was subjected to some "standard" shock motion. The evaluation of the mount, in regard to its ability to protect the equipment, was measured by the maximum forces or accelerations experienced by the elemental masses attached to the equipment. The evaluation, therefore, can be given only in terms of frequency. A curve in which the ordinate represents the maximum accelerations experienced by the elements and in which the abscissa represents the natural frequencies of the elements, when the mount is excited by a standard shock motion, constitutes an evaluation of the protection provided by the mount. The curve frequently is called the shock spectrum and the maximum accelerations are commonly called "equivalent static accelerations." A comparison of the qualities of different mounts is made by comparing the magnitude of the shock-spectra curves obtained with different mounts.

In addition, measurements of the force transmitted by a mount as a function of deflection across the mount is determined for various standard shock motions. This defines important physical properties of the mount, such as stiffness, energy storage, and energy loss, under dynamic conditions corresponding to use of the mount.

Acknowledgment

The authors wish to express their appreciation to the staff of the Rubber Laboratory of the Mare Island Naval Shipyard for their assistance relating to the hammer-drop tests. They also acknowledge their indebtedness to Messrs. John L. Bachman, Robert C. Cowan, and Arthur F. Dick, who performed many of the remaining experiments.

ASME Survey Questionnaire. . .

Here Is the Raw Material!

At the December, 1952, meeting of the Council of The American Society of Mechanical Engineers, the Committee on Society Policy recommended that

"The importance of developing the specialized interests in the Society is paramount and to that end this Committee urges that Council urge the Organization Committee to take the lead in clarifying the committee structure and interrelationships of the Professional Divisions and bring in a solution at the earliest possible moment."

The Organization Committee soon realized that, to carry out this task, it needed a current picture of the specialized interests of its members and requested an appropriation to provide a direct-mail circularization of the entire membership, to discover their special skills and interests. The Council granted the request at its Los Angeles meeting in June, 1953.

The development of the questionnaire was assigned to a committee of three, representing the Organization Committee, the Professional Divisions Committee, and the Publications Committee. The questionnaire, in order to determine the interests of the members functionally, technically, and industrially, and to relate these interests to the local and national technical programs of the Society and its publications, became rather complex.

A copy of the questionnaire was mailed to 36,741 members in July, 1954. Returns were prompt. At the time they were tabulated in October, 1954, there were 20,575 returns—56 per cent. This is believed to be an adequate sample to represent the interests of the active membership of the Society. Some questions have been raised as to the possible failure of the returns to represent an accurate cross section of age groups. However, it is reasonable to suppose that the returns are representative of the membership most in need of the service which the Society can render and most interested in its success in serving its field. Indeed, there was a gratifying response to the opportunity for comments which the questionnaire provided. These are being grouped for study and ultimately will be brought to the attention of the Council, appropriate committees, and the membership at large.

The complete tabulation of the returns is printed in this issue of MECHANICAL ENGINEERING. This is the raw material for an analytical study of the entire technical program of the Society, including its publications. In the next issue will appear some of the more obvious correlations. These and others will be placed in the hands of Society officers and committees, who may find them suggestive of further analyses which may be useful in improving the service which it is the obligation of the Society to render to its members.

Membership Survey Committee

C. B. Peck, Chairman
O. de Lorenzi
T. F. Perkinson

Initial Report—Tabulation of Responses Only

Questionnaires sent—36,741; returned—20,575 or 56 per cent

1. What is your PRINCIPAL employment status? Please check ONE only.

a. Self-employed	1113
b. Employee of:	
1. Private firm or corporation	16904
2. Federal, state, or municipal government	799
3. Educational institution (association, library, etc.)	750
c. Member of armed forces	415
d. Retired	142
e. Other	81

2. What is the INDUSTRY OR BUSINESS with which you are connected?

In the FIRST column please check the ONE item which best represents the product or service with which your PRIMARY work is concerned.

In the SECOND column please check the ONE item which best represents the product or service with which your SECONDARY work is concerned.

2. (continued)

MANUFACTURING

	Prim.	*Sec.*
Abrasives	28	22
Asbestos and nonmetallic mineral products	69	40
Boilers and steam-generating equipment	674	452
Chemicals and allied products	914	464
Clay and glass products (refractories)	123	45
Electrical machinery, equipment, and supplies:		
Apparatus (generating, transmission, distribution, and other industrial apparatus)	587	331
Appliances	132	152
Equipment for motor vehicles, aircraft, and railway locomotives and cars	265	302
Communication and electronic equipment and related products	630	387

2. *(continued)*

Miscellaneous electrical products (x-ray, batteries)	83	83
Fabricated metal products, small tools, and hardware (except ordnance, machinery, and transportation equipment)	590	504
Food, tobacco, and kindred products	230	103
Fuel-burning equipment	136	341
Instruments & regulators, precision-measuring devices	677	478
Leather products	16	13
Machinery (except electrical):		
Agricultural machinery and tractors	109	84
Construction and mining machinery and equipment	172	123
Gas turbines	354	311
Household and service-industry machinery (air conditioning, refrigeration, laundry equipment, filling-station equipment, water softeners, etc.)	244	187
Industrial Machinery and Equipment:		
Compressors and pumps	365	300
Elevators and lifts	39	39
Materials-handling equipment	258	250
Other	353	201
Internal-combustion engines	218	224
Machine tools, presses, metal-working machinery	392	341
Office machines and devices	133	61
Power-transmission equipment	133	195
Rocket and jet-propulsion machinery	320	242
Special-Industry Machinery:		
Food	75	91
Printing	42	24
Textile	77	92
Wood	27	25
Other	182	166
Steam engines and turbines	239	197
Optical and photographic	119	60
Ordnance	359	364
Paper and paper products	228	121
Petroleum and coal products	563	267
Piping and pipe fittings	181	271
Plastics (materials & trade molding)	102	160
Primary metal industries:		
Blast furnaces, steel works, and rolling mills	231	107
Iron and steel foundries	98	91
Nonferrous foundries	30	39
Smelting and refining of nonferrous metals	78	43
Rolling, drawing, and alloying of nonferrous metals	98	81
Miscellaneous (forgings, wire drawing, etc.)	63	94
Printing and related products	63	72
Rubber products	141	75
Stone and cement products	47	38
Textiles	188	133
Transportation equipment:		
Motor vehicles and equipment	255	164
Aircraft and parts	671	428
Ship and boat building and repairing	93	79
Railroad equipment	146	138
Wood industries	65	65
Miscellaneous industries (jewelry, music, sporting goods, toys, etc.)	42	50
AGRICULTURE, FORESTRY, AND FISHERIES	18	40
COMMERCE, FINANCE, REAL ESTATE	38	37

2. *(continued)*

COMMUNICATIONS AND PUBLIC UTILITIES		
Electric light and power industry	865	393
Gas	127	126
Telecommunications (incl. radio and TV broadcasting)	56	80
Water supply	30	66
CONSTRUCTION		
General construction (buildings, highways, waterworks, etc.)	342	535
Trade construction (plumbing, painting, carpentry, etc.)	207	236
EDUCATION		
Engineering schools	825	201
Professional societies	20	46
Publishing	46	45
Other schools, libraries, museums	38	43
GOVERNMENT AGENCY		
Armed forces	501	171
Civilian—federal, state, and local	435	133
INSURANCE AND APPRAISALS	97	27
MINING		
Coal	32	13
Metals and minerals	46	43
Petroleum, natural gas	91	64
NUCLEAR-ENERGY APPLICATION	342	257
SERVICES		
Architect, lawyer, and other professional services	92	124
Consulting engineer	920	923
Patent attorney	38	60
Research agencies	295	364
Miscellaneous business services (advertising, trade association, etc.)	37	50
TRANSPORTATION (Not including manufacturing)		
Air	31	58
Highway	13	18
Pipe line	64	65
Railway	141	56
Water	31	28
OTHER	628	582

3. *What is your major ACTIVITY or function in connection with your occupation? ("Administration" applies only to top-level management; for example, a production manager should check "production.") Please check ONE only.*

a. Administration	2405
b. Consulting	1104
c. Design, application	5810
d. Estimating	330
e. Inspection	302
f. Legal (patents, etc.)	59
g. Marketing, distribution (sales)	1460
h. Operation, maintenance	1692
i. Placement, training	96
j. Production	1224
k. Purchasing, procurement	136
l. Research, development	2965
m. Teaching	734
n. Technical writing, editing	172
o. Testing	554
p. Other	666

4. What are the FIELDS OF SPECIALIZATION in which your work and interests lie?

In the FIRST column please check only ONE item which represents the principal field in which your WORK lies.

In the SECOND column please indicate by numbers from 1 to 5 in order of preference, the additional fields in which your OTHER INTERESTS lie.

		Fields of Other Interests				
	Principal	*1*	*2*	*3*	*4*	*5*
a. Aerodynamics	136	213	255	191	157	158
b. Aeronautics	409	425	250	196	177	202
c. Applied mechanics	738	692	539	446	442	371
d. Chemistry	173	158	116	159	136	167
e. Combustion	472	694	605	458	383	298
f. Construction	827	602	465	425	393	422
g. Corrosion	58	132	201	231	232	287
h. Electricity	457	404	415	418	345	325
i. Electronics	349	325	376	327	336	324
j. Engineering economics	307	663	606	623	605	530
k. Fluid mechanics	312	477	602	553	445	354
l. Gas-turbine power	397	466	387	390	379	290
m. Heat transfer	481	710	827	782	628	511
n. Heating and ventilating	759	605	543	522	479	418
o. Hydraulics	444	486	616	634	449	405
p. Instrumentation	650	507	590	656	633	603
q. Kinema ics (mechanisms)	124	406	537	443	371	309
r. Lubrication	153	150	266	303	302	271
s. Machine design	2112	1434	1019	791	717	572
t. Management techniques:						
1) Cost accounting	35	101	177	205	186	189
2) Evaluation and appraisal	172	241	260	248	236	218
3) Industrial relations	76	277	316	305	296	244
4) Organization	591	783	563	491	420	402
5) Plant layout and design	506	578	608	563	443	353
6) Production planning and control	455	437	533	407	321	288
7) Statistical controls (quality, etc.)	76	96	139	199	176	191
8) Time study, methods, incentives, etc.	249	143	183	238	194	197
9) Other	218	61	19	13	25	25
u. Marine engineering	155	133	134	118	122	117
v. Materials engineering	181	211	316	374	355	321
w. Materials handling	329	295	370	412	461	419
x. Mathematics	35	203	256	329	399	351
y. Metallurgy	150	212	282	363	369	379
aa. Naval architecture (or ship design)	44	51	55	60	58	75
bb. Nucleonics (or nuclear engineering)	228	178	163	176	195	233
cc. Oil and gas power	253	225	235	265	275	247
dd. Optics	27	35	42	44	64	55
ee. Ordnance	376	95	98	113	146	168
ff. Physics	34	116	130	207	234	286
gg. Piping	318	354	487	455	431	394
hh. Power	1592	812	539	504	518	419
ii. Process engineering	897	550	535	462	519	457
jj. Product engineering	1039	706	485	476	537	494
kk. Safety	100	57	79	151	183	238
ll. Sanitary engineering	43	55	73	86	99	93
mm. Standards	74	73	114	127	170	245
nn. Structural design	183	188	267	282	320	310
oo. Textile engineering	118	45	28	44	52	63
pp. Thermodynamics	358	634	621	598	597	599
qq. Welding	75	133	214	257	255	365
rr. Other	973	200	83	76	49	91

5. How active have you been in your Section, or Subsection, during the last year, as measured by your attendance? Please check ONE only.

a. Have attended none of the meetings	11111
b. Have attended about 25% of the meetings	6101
c. Have attended about 50% of the meetings	1318
d. Have attended about 75% of the meetings	1317
e. Have attended all of the meetings	443

6. What is the MAIN reason you attend the Section meetings? Please check ONE only.

a. Interested in technical subjects	7322
b. Enjoy personal contacts	2204
c. Feel it helps professionally	2790
d. Enjoy extra-curricular activities	663

7. What is the MAIN reason for your missing Section meetings? Please check ONE only.

a. Inadequate announcement	488
b. Not interested in program	4274
c. Other commitments	9134
d. Commuting difficulties	3743
e. Don't like the group	86
f. Don't know of a nearby Section	588
g. Other reasons	1352

8. Papers which are presented at the Spring, Semi-Annual, Fall, and Annual Meetings, as well as some Division Meetings, may be classified in three broad groupings. Please indicate your major preference of subject-matter treatment for ASME meetings by checking ONE only.

a. Theoretical aspects	2261
b. Practical aspects	12455
c. Commercial aspects	2001
d. No preference	3055

9. What ASME publications do you now receive in addition to MECHANICAL ENGINEERING? Please check as many as apply.

a. Transactions	2414
b. Journal of Applied Mechanics	1722
c. Applied Mechanics Reviews	511
d. Preprints (Technical Papers)	5375
e. Mechanical Catalog	11004
f. Membership List	3417

10. How do you feel that MECHANICAL ENGINEERING serves your engineering and professional needs? Please check ONE only.

a. Very well	2898
b. Well enough	8126
c. Not very well	6470
d. Not at all	873
e. Undecided	1819

11. About how much time on the average do you spend reading each issue of MECHANICAL ENGINEERING? Please check ONE only.

a. Do not read	549
b. $^1/_2$ hour	5651
c. 1 hour	7111
d. $1^1/_2$ hours	2666
e. 2 hours	2733
f. More than 2 hours	1591

12. Which THREE of the following would you like to see increased, or added to, in MECHANICAL ENGINEERING? Please enter numbers from 1 to 3 in order of importance.

	1	2	3
a. ASME News	325	256	488
b. Technical Papers:			
1) Theoretical—Analytical	2002	1381	701
2) Practical—Application	6896	3246	1525
c. Management Papers	2294	1918	1325
d. Addresses on professional and economic aspects of the mechanical engineer	1207	1815	1761
e. General-Interest Articles	2318	3293	3400
f. Briefing the Record	1071	1578	1485
g. Technical Digest	749	1916	3021
h. Keep Informed	783	1440	2609
i. Other	189	52	158

13. Through what CHIEF source do you secure information to order ASME technical papers? Please check ONE only.

a. Lists of available papers in Mechanical Engineering	6471
b. Technical Digest in Mechanical Engineering	2254
c. Programs of Meetings	2468
d. At Meetings of the Society	903
e. Do not order papers	7263

14. How many ASME technical papers did you obtain at ASME MEETINGS during the past year? Please check ONE only.

a. None	14509
b. 1 to 5	3254
c. 5 to 10	1210
d. Over 10	761

15. How many ASME technical papers did you order BY MAIL during the past year? Please check ONE only.

a. None	12363
b. 1 to 5	5100
c. 5 to 10	1855
d. Over 10	601

16. We need some information about you. First, about your education. Please check here only the HIGHEST degree you obtained.

a. None	1557
b. Bachelor's—AB, BS, etc.	10533
c. Professional—ME, EE, etc.	4933
d. Master's—MS, MA, etc.	2713
e. Doctorate (earned)	587

17. Do you wish that you had spent more time on liberal-arts subjects at the expense of technical subjects in your academic work?

a. Yes	4782
b. No	13124
c. Undecided	1779

18. How many years have elapsed since your undergraduate degree was awarded (as of June, 1954)? If you do not have a degree, please check number of years in the profession.

a. Less than 1	204
b. 1 or 2	1850
c. 3 or 4	3443
d. 5 or 6	2925
e. 7 or 8	1247
f. 9 or 10	934
g. 11 to 15	2434
h. 16 to 20	1747
i. 21 to 25	1383
j. 26 to 30	1314
k. 31 to 35	1101
l. 36 to 40	635
m. Over 40	977

19. Please check age bracket to your nearest birthday.

a. 24 or younger	738
b. 25 or 26	1279
c. 27 or 28	2049
d. 29 or 30	2607
e. 31 or 32	2281
f. 33 or 34	1727
g. 35 to 39	2507
h. 40 to 44	1784
i. 45 to 49	1359
j. 50 to 54	1402
k. 55 to 65	1807
l. Over 65	812

20. Current data on your annual earnings from the practice of the profession will provide valuable and useful information to the Society. Remembering that this Questionnaire is anonymous, please check the appropriate box. Do not include income from investments or other sources. If you prefer not to answer this question, you may so check and continue with the balance of the Questionnaire.

a. Under \$4,000	440
b. \$4,000 to \$4,999	1580
c. \$5,000 to \$5,999	3785
d. \$6,000 to \$6,999	3143
e. \$7,000 to \$7,999	2447
f. \$8,000 to \$8,999	1664
g. \$9,000 to \$9,999	1307
h. \$10,000 to \$14,999	3020
i. \$15,000 to \$24,999	1424
j. \$25,000 and over	880
k. I do not desire to answer	394

21. *Of what other professional societies or associations are you a member? Please check as many as apply.*

AAAS	American Association for the Advancement of Science	350
ACS	American Chemical Society	241
AIA	American Institute of Architects	31
AIChE	American Institute of Chemical Engineers	225
AIEE	American Institute of Electrical Engineers	578
AIIE	American Institute of Industrial Engineers	193
AIME	American Institute of Mining & Metallurgical Engineers	242
AIP	American Institute of Physics	18
AMA	American Management Association	360
AREA	American Railway Engineering Association	64
ARS	American Rocket Society	174
ASAE	American Society of Agricultural Engineers	51
ASCE	American Society of Civil Engineers	252
ASEE	American Society for Engineering Education	766
ASH&VE	American Society of Heating & Ventilating Engineers	581
ASLE	American Society of Lubrication Engineers	156
ASM	American Society for Metals	574
ASQC	American Society for Quality Control	144
ASRE	American Society of Refrigerating Engineers	182
ASSE	American Society of Safety Engineers	116
ASTE	American Society of Tool Engineers	494
ASTM	American Society for Testing Materials	305
AWS	American Welding Society	263
AWWA	American Water Works Association	151
IAS	Institute of Aeronautical Sciences	355
IRE	Institute of Radio Engineers	151
ISA	Instrument Society of America	328
NAPE	National Association of Power Engineers	275
NSPE	National Society of Professional Engineers	1832
SAE	Society of Automotive Engineers	1092
SAM	Society for the Advancement of Management	365

21. *(continued)*

SAME	Society of American Military Engineers	434
SMPTE	Society of Motion Picture and Television Engineers	31
SNAME	Society of Naval Architects and Marine Engineers	304
SPE	Society of Plastics Engineers	77
TAPPI	Technical Association of the Pulp and Paper Industry	227
	Other	907

22. *Are you a Registered or Licensed Professional Engineer?*

a. Yes, in one State only	6424
b. Yes, in more than one State	1322
c. No	12423

23. *If the answer to Question 22 is "yes," do you feel this has been of importance to you in your work?*

a. Yes	3950
b. No	3960

24. *If the answer to Question 22 is "no," are you registered as an Engineer in Training?*

a. Yes	2640
b. No	9179

25. *If the answer to Question 22 is "no," is it your intention to become a registered engineer?*

a. Yes	6253
b. No	4742

26. *If you are a member of the Military and Naval Establishment, please check the ONE category below which best describes your affiliation:*

Regular (Army, Navy, Air Force, Marine Corps, Coast Guard)	247
Reservist on active duty:	
(a) On temporary active duty (Satisfying statutory requirements of not more than three years)	290
(b) On extended active duty	94
Reservist not on active duty:	
(a) Member of Ready Reserve	1109
(b) Member of National Guard	62
(c) Member of Standby Reserve (active list)	631
(d) Member of Standby Reserve (inactive list)	1444
(e) Member of Retired Reserve	381

27. *If you are a member of the Military and Naval Establishment, are you commissioned or enlisted?*

(a) Commissioned	3513
(b) Enlisted	431

The purpose of the 1954 ASME Membership Survey Questionnaire is to improve service to the entire membership of the Society. Facts about members' interests and activities were assembled and correlated in order to: (1) Improve the organization of the Professional Divisions; (2) study the possibility of grouping papers of related divisions in a number of sections of Transactions (like the *Journal of Applied Mechanics*); (3) obtain information for planning and programs for National, Regional, and Section Meetings and Conferences; and (4) improve member service by consideration of opinions about MECHANICAL ENGINEERING and Transactions of the ASME. The Questionnaire was anonymous and urged a free expression of opinions and comments. All responses were recorded on tabulating-machine punch cards resulting in the foregoing tabulations. Correlations of some of the questions will form the basis of a second article to appear in the April, 1955, issue of MECHANICAL ENGINEERING.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Associate Editor*

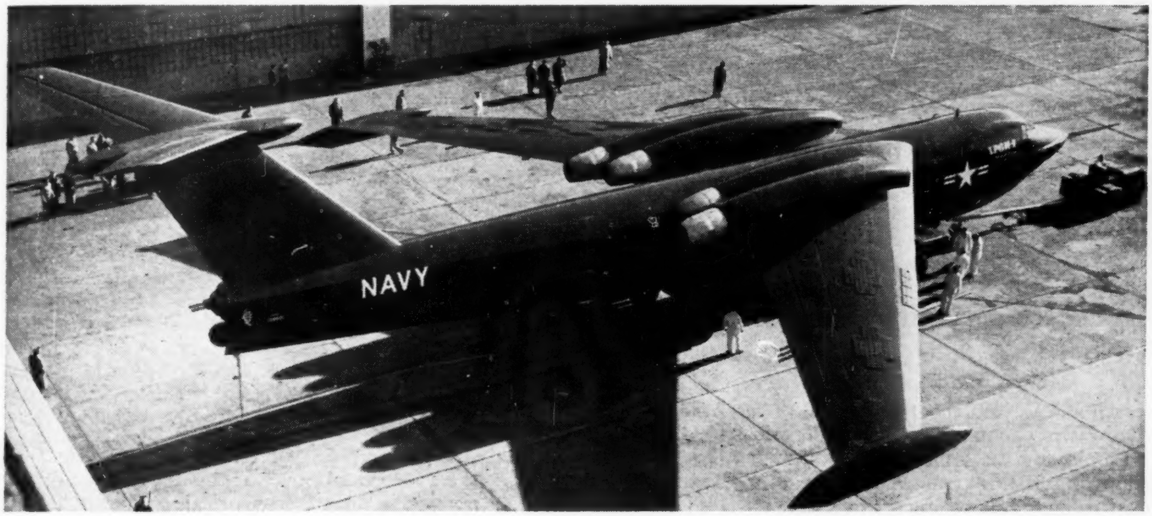


Fig. 1 A huge T-shaped tail towers three stories high above the Martin SeaMaster's swept wings and long slender hull. Small checkerboardlike objects on the wings are rubber pressure pads cemented on for simulated load tests by which the wings will be tested for maximum design air-load strength. Pads will be removed prior to first flight.

Multijet Seaplane

THE world's first multijet seaplane was unveiled recently by the U. S. Navy and its manufacturer, Martin Aircraft of Baltimore, Md.

The big, swept-wing flying boat, designated the XP6M-1 and called the SeaMaster, was built for the Navy at Martin's Middle River plant.

As big as a commercial airliner and powered by four jet engines, the SeaMaster is in the over 600-mph class of aircraft and cruises above 40,000 ft.

Its two primary missions are mine laying and photo-reconnaissance, but this water-based plane can perform other combat tasks, the announcement said.

The plane carries a crew of five. Its long, sleek, and narrow hull ends in a gigantic "T"-shaped tail which towers at least three stories high. Its four Allison J-71 jet engines are equipped with afterburners, company officials revealed, to give the craft additional speed and power.

The engines are mounted atop the sharply sweptback wings in such a manner they are easily accessible, even when the plane is afloat at sea, it was pointed out.

The SeaMaster, designed to remain in flight for long periods of time, can operate in high waves and in areas of the world where seaplanes have not frequently operated.

Its radical design and tremendous potentialities have made possible an entirely new concept in aerial warfare.

For the first time, with the use of high-speed water-based aircraft, the means are now provided to operate in or near enemy waters independent of fixed installations or foreign bases, the company reported.

An outstanding feature of the SeaMaster is its rotary mine door, a Martin development which permits the big flying boat to sow mines or drop charges while streaking along at speeds rivaling that of fighter planes. The door is self-sealing, making it watertight.

Martin also announced that it is already producing a portable dock for use in servicing while the plane is afloat. This, officials explained, eliminates beaching. The dock can be knocked down for storage aboard ship. It can also be transported by air.

Jet-Plane Launcher

PILOTED jet-fighter planes are being launched like guided missiles, the Air Force and Martin Aircraft revealed recently.

Using platforms mounted on trucks to explore the possibility of eliminating runways under certain combat conditions, the world's first flights of conventional jet fighters without preliminary take-off runs were hailed as ushering in a new era in aerial warfare.

The launching technique was developed by the Air Re-

Fig. 2 This Air Force jet fighter is the first piloted plane to be air-borne from a zero-length launcher. Use of zero-length launchers may eliminate the need for front-line airstrips.

search and Development Command of the Air Force and the Martin Company of Baltimore, Md.

Employing the same principle and equipment used in launching the Martin Matador, an Air Force guided missile, engineers conducted experiments at Edwards Air Force Base, Calif. The historic flights were made by F-84-G Thunderjets.

Standard production Republic Thunderjets were modified so booster bottles could be attached beneath their tails. The boosters are the same type and size used on Matadors.

Highly mobile trucks with "arms" raised the fighter planes to the launching angle and became the world's smallest airports. With the plane's turbojet engines running at full speed, the thrust of the booster bottles kicked the fighters off so swiftly they were immediately air-borne.

The shock of the unconventional take off was said to be less than pilots experience during catapult take offs. The planes were always under the pilot's control and a peak acceleration of 4 *G* was reached.

Because the launchers are so mobile, they can be moved quickly from one place to another, an Air Force spokesman explained. He said no permanent installations are necessary—no runways, hangars, or other construction.

The developers of the launching system envisioned jets operating close to front lines and presenting minimum targets to enemy bombers. Conventional landings could be made at forward bases and the aircraft immediately dispersed for maximum protection while readying for the next flight.

Zero-length launching, while not a new development, has been proved by nearly 200 Matador launchings by ARDC and the Tactical Air Command and Martin engineers during the past several years. The Thunderjets, considerably larger and heavier than the guided missile, have demonstrated that the technique is applicable and practical for fighters, the Air Force said.

Flutter Research

Progress was reported recently on investigations into "flutter"—one of several possible causes of jet-engine failures. Three aeronautical engineers in the Research Division of New York University's College of Engineering disclosed the results of a 2 1/2-year study of the phenomenon at the 23rd annual meeting of the Institute of the Aeronautical Sciences in the Hotel Sheraton Astor, New York, N. Y. The three are Dr. Chi-Teh Wang, Dr. Frank Lane, and Robert J. Vacarro.

Flutter, an engineering term describing a specific type of vibration, is suspected to be a frequent cause of blade failure in the compressor and turbine units of jet engines. Jet engines consist of rows of blades radiating from disks mounted on a shaft. Since each stage of a compressor and turbine may have from 30 to 100 blades, one engine may have hundreds of them.

If just one blade fails, it may rip off those near it or jam the system.

Failure due to flutter comes from a combination of vibratory twisting and bending effects.

A new theory evolved in the NYU study makes it possible to determine critical speeds (speeds at which flutter occurs) in specific instances. Critical speed determination is one of the prinicpal aims of flutter research.

Flutter can be caused by natural winds on structures other than aircraft, as in the case of the collapse of the Tacoma, Wash., Narrows Bridge in 1940.

In flight, it is induced by a combination of such factors as air motion due to the speed of the plane or rotation of the blades, and the elastic characteristics and weight distribution of the structure. How each of these factors might contribute to the onset of flutter in compressor or turbine blades is one of the goals of the research project.

Knowledge of external flutter—that applying to the entire plane or to large sections like fuselage, wing, and

tail—is well developed, though scientists are continuing extensive studies in the field.

Drs. Wang and Lane and Mr. Vacarro concentrated on the means of analyzing internal flutter problems. Their work at NYU was done under contract with the Air Force.

There are several reasons, they pointed out, why the lessons learned from research on external aircraft flutter were not sufficient for internal flutter problems. Among these are the facts that compressor and turbine blades are highly twisted and that they operate with high centrifugal force because of their high rotational speeds.

Even more complicating, however, is the effect that flutter in one blade has upon all others.

The NYU researchers have succeeded in reducing the analysis of multiblade flutter to the treatment of a single equivalent blade, they reported. One immediate result is a greater reduction in the number of equations required in the analysis of internal flutter problems.

Theoretical solutions to the flutter-analysis problem in certain specified cases were verified experimentally, the scientists reported. This was done in the experimental wind tunnel at NYU's Guggenheim School of Aeronautics. An air flow to simulate flight conditions was sent over a series of airfoils (winglike structures) constructed to simulate the blade row in an engine compressor. (The experimental rig looked somewhat like a venetian blind with the slats mounted on springs.) There has been "excellent agreement," the researchers said, between experimental results and theory in all cases studied to date.

The new theory does away with certain assumptions that had been made in previous analysis of internal flutter, for example, the assumption that all blades will flutter in phase. This, the scientists said, was found to be unjustifiable.

The NYU research team now has begun to investigate stall flutter, another possible factor in engine failures. Stall flutter occurs when the smooth pattern of the air flow over the blade surfaces is broken.

Silicone Lubricant

Development of what is believed to be the first silicone lubricant for jet aviation and industry—capable of operating at temperatures of 400 F or more—was announced by General Electric Company's Silicone Products Department, Waterford, N. Y.

Combining the lubricating qualities of hydrocarbon with the unique properties of silicones, the new G-E silicone lubricant was developed to help equipment designers crack the thermal barrier. Accelerating speeds of jet aircraft have created a need for suitable lubricants tough enough to shrug off searing temperatures. The lubricant will also operate at —100 F temperatures, it was reported.

The lubricant's industrial usefulness has been demonstrated by such bench-test data as the Shell Four-Ball and Falex tests. The lubricant's performance is effective in "steel on steel" use, and it is applicable to most industrial purposes.

It was emphasized that 81406 lubricating fluid and 81482 lubricating grease are developmental products, but they probably will be available commercially during 1955.

According to G-E engineers, the new G-E fluid and grease lubricate about as effectively as both the lubricating and hydraulic types of hydrocarbons. They said that both types of lubricants will permit the design of new military and industrial equipment, hitherto hindered from operation at high temperatures because of lack of suitable lubrication. The G-E lubricants are also expected to reduce maintenance costs as well as increase the reliability of operating equipment.

Both the lube fluid and grease show little change in viscosity or consistency at high temperatures, and are said to resist shear breakdown.

Aircraft Instrument Panel

A new aircraft instrument panel which presents data in the form of a readily understood picture, instead of through conventional dials, has been disclosed by the U. S. Navy.

Douglas Aircraft Company served as a co-ordinator for the aviation-instrument manufacturers engaged in the project, which involves the use of a flat, transparent television-picture tube. The radically different type of tube, making possible the graphic presentation of data, was developed as a proprietary item by Willys Motors, Inc.

Based on research in human engineering, the new panel is a development of a long-range program of the Office of Naval Research and the Bureau of Aeronautics. The Navy expects the first experimental plane using this system to be flown about 1958.

Specific purposes of the research program are: To simplify cockpit instrumentation, to provide all-weather operation, and to reduce drastically the cost of future aircraft.

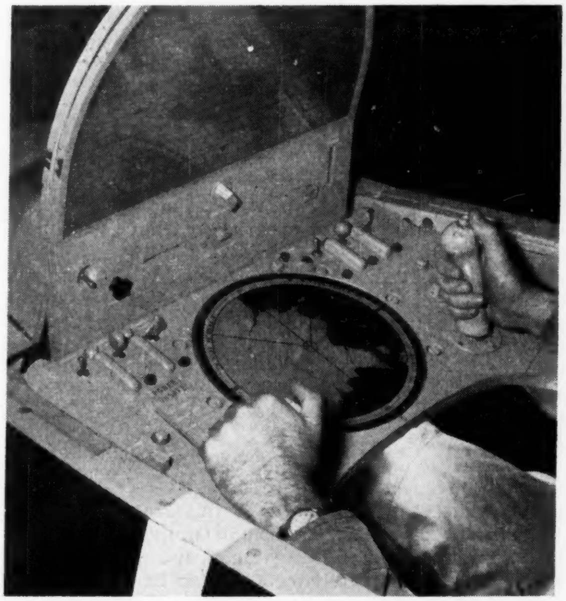


Fig. 3 Mock-up of future aircraft instrument panel shows horizontal and vertical flat-plate television tubes, replacing conventional dials. Simplified control system will be reduced to stick and throttle.

One aim of the Navy's long-range program is to reduce the control system to two basic items: A control stick and a throttle. Six switches would be used to select information for specific situations such as take off and landing. The instrument panel itself is expected to consist of only two basic instruments, both television tubes. One would be a semicircular plate mounted vertically in front of the pilot. This transparent plate, which would not interfere with the pilot's vision during contact flight, would show altitude, speed, and attitude of the plane. Physical features, such as mountains, would be depicted artificially. From this instrument the pilot would obtain necessary information about the three axes of the aircraft pitch, roll, and yaw.

The second instrument, a round plate mounted horizontally inside the cockpit rim, would provide necessary information for navigation and traffic control in a readily assimilated way.

Because both instruments are television tubes, it will be possible to selectively superimpose into them fuel consumption, power settings, and other data.

Instead of an actual picture of the physical features of the earth, the pilot would see an analogy of the world he would see if flying in clear weather.

The picture concept was based on human-engineering research which revealed that a picture is more readily comprehended than the dials of a conventional instrument panel.

83,000-Hp Motors

THE world's two most powerful motors, built by Westinghouse Electric Corporation, were given their official "start up" at the Air Research and Development Command's Arnold Engineering Development Center, Tullahoma, Tenn., ARDC headquarters, in Baltimore, Md., announced recently.

Built at the East Pittsburgh, Pa., plant of Westinghouse for use in the Air Force's new transonic and supersonic propulsion wind tunnels at AEDC, the two giant 83,000-hp motors were set into motion at the rate of 600 rpm by two "starting" motors, each having a 25,000-hp rating. The combined rating of all four motors, when the installation is completed, will be 216,000 hp.

The entire rotating machine, including the two 83,000-hp units and the two "small" motors connected in tandem fashion to five even larger compressors, will be about 600 ft long.

A single shaft through this machine will be capable of driving the world's largest rotating wind-producing device for testing and evaluating supersonic planes, aircraft engines, and guided missiles. When the wind tunnels are in full operation, man-made gales will race around two separate courses inside a huge pipe that is nearly wide enough to hold both tubes of New York's Holland Tunnel.

Each of the 83,000-hp motors weighs 225 tons. The four motors together will use enough electric power to supply the entire city of Nashville, Tenn. The wind tunnels will require 100,000 gpm of cooling water.

Despite the tremendous weight and speed of the motor and compressor system, it can be brought to a halt in about three minutes by using the wound rotor motors as brakes. In this fashion, energy is dumped into liquid rheostats—the world's largest—which are used for secondary control.

Fig. 4 Over-all view of Commonwealth Edison Company's Ridgeland Station turbine room, showing wrecked low-pressure Unit No. 4. Miscellaneous damage to other units is visible in background.

Ridgeland-Station Accident

THE low-pressure turbine of a cross-compound generating unit with a capability of 160,000 kw exploded on Dec. 19, 1954, at Commonwealth Edison Company's Ridgeland Station, apparently due to metal failure in the turbine-spindle shaft. The basic cause of this failure has not yet been determined.

The unit (No. 4) is one of four of the same size in this station. Flying pieces of metal damaged the other three units and the station was completely shut down. The accident occurred at 11:19 p.m., Sunday. Unit 2 was put back on the line Tuesday at 12:43 p.m., Unit 1 at 5:34 p.m. the same day, and Unit 3 at 1:20 a.m. Wednesday. All three units, therefore, were restored to service within 50 hours.

Ridgeland Station is the newest on the Edison system. It is located on the Chicago Sanitary and Ship Canal, about two miles west of the city limits. Construction on this station was begun in 1948 and the four units had a total net capability of 640,000 kw. Unit 4, built by Allis-Chalmers Manufacturing Company, had been in commercial operation since August, 1954, had passed every normal test, and had given no previous evidence of trouble.

At the time of the accident, the unit had been out of service for two days for cleaning of the boiler. It is a regular practice after a turbine outage to recheck the overspeed trip before placing the machine back in service. In this case, it meant separately checking the overspeed trip on both the high-pressure and low-pressure elements of the turbine.

The low-pressure element, with a normal speed of 1800 rpm, had been given its overspeed check and had tripped within the 10 per cent limit. The high-pressure element was being brought up for its overspeed check when the failure occurred.

There were six men on the floor at the time engaged in this operation. Five were Edison men and one the manufacturer's representative. Two Edison men were killed by flying metal and the four men suffered either broken bones or shock. No one else either inside, or outside the station, received injuries but three were treated for shock.

The explosion occurred before the machine had come up to the trip speed for the high-pressure unit. The

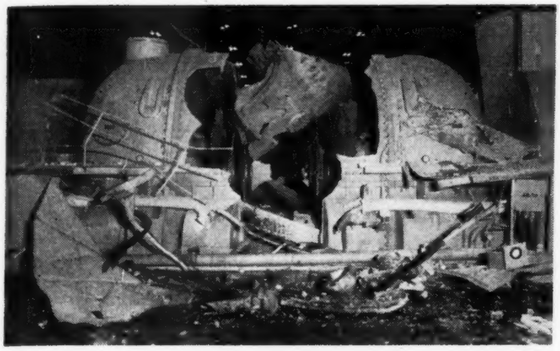


Fig. 5 Close-up of low-pressure Unit No. 4 at Ridgeland Station. Center section of turbine-spindle shaft with eight rows of blades is missing. Stub shafts and double exhaust blades remain in place.

high and low-pressure units were operating in synchronism but were not connected to the bus.

The center section of the spindle shaft, approximately 7 ft in diam and 4 ft long, broke into a number of pieces which were thrown out of the machine along with much of the turbine casing. One section weighing several tons went through the roof of the building and landed in the coal pile to the west of the station building. Another, of comparable size, traveled east and ripped open the tailpipe on the Unit 1 condenser 300 ft away.

Other pieces cut through the crossover pipes between the intermediate and low-pressure elements of both Unit 2 and Unit 3. One piece also cracked the casing on the low-pressure element of Unit 3. Miscellaneous damage was done throughout the turbine room by other flying metal. The most extensive building damage was done to the roof structure.

Unit 1 and Unit 3 were tripped automatically and Unit 2 was tripped by the operator in the control room. The operators remained at their posts and went through their orderly procedure for shutting down the boilers.

At the time the accident occurred, the other three units at Ridgeland were carrying a load of 460,000 kw, out of a total system load of 1,850,000 kw. System load was dropping rapidly at the time, and other units were able to respond to the demand without material loss of frequency or other disturbances. The tie lines to the neighboring systems to the east, which normally carry no load at this time of the day, picked up 190,000 kw. This part of the load was transferred to Chicago area stations within a few minutes.

A most difficult problem was the picking up of the Monday morning, daytime, and evening loads with 640,000 kw of Ridgeland capacity out of service. There was a good possibility that this load would be the all-time system peak. Over 600 large customers were called on to reduce their demands by 25 per cent and the general public was requested to co-operate by reducing load wherever possible. Purchases from other companies over interconnections were made to the extent of approximately 200,000 kw. With these measures the system load was carried successfully.

A remarkable repair job was done within a very short time. A new tailpipe, 12 ft long, 5 ft in diameter, and made of $^1/_2$-in. steel, was fabricated and welded into place in order to restore Unit 1 to service. The crossover pipes on Unit 2 and Unit 3 both had been cut severely, and new sections of pipe had to be welded into place where damage was done. The casing of Unit 3 had been cracked by flying steel. The crack was sealed by the metal-lock method and a section of steel plate was riveted on for added strength. The hydrogen-control panel for Unit 3 had been wrecked and was replaced by a panel from Will County Station now under construction.

Investigations are being made to determine the basic cause of the spindle-shaft failure. The spindle design is not unusual. The forging itself was subjected to all well-established factory tests including ultrasonic and tests associated with interior boring.

A large part of the damage is expected to be covered by the manufacturer's warranty and by the Company's insurance.

Electric-Power Plants

Two major electric-power plants, which will be the largest ever built by private industry when completed, are now officially in operation.

The Ohio Valley Electric Corporation announced that its Clifty Creek Plant at Madison, Ind., and Kyger Creek Plant at Cheshire, Ohio, are delivering kilowatts to the U. S. Atomic Energy Commission's gigantic new uranium diffusion plant near Portsmouth, Ohio—and, most importantly, they are on time.

The first 200,000-kw turbogenerating unit at each of the two plants has been placed in service and their power is being delivered to the Portsmouth project via OVEC's new 330,000-volt transmission system. Clifty Creek Unit 1 went into operation approximately on schedule,

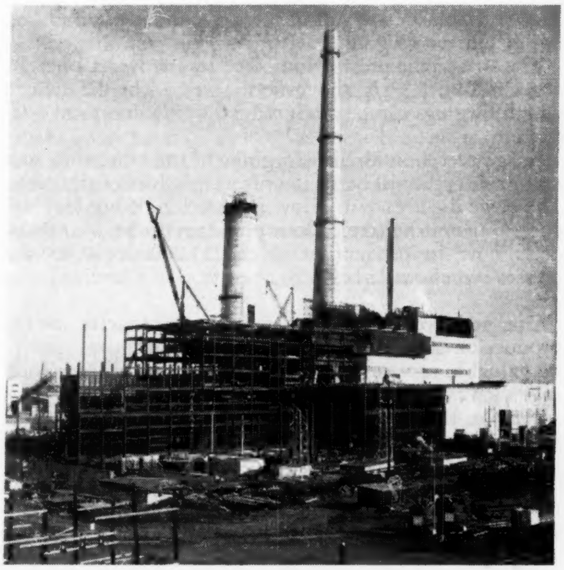


Fig. 6 Upon completion in 1956, the Kyger Creek Plant at Cheshire, Ohio, will have a generating capability of 1,000,000 kw and will be one of the world's largest steam-power stations. It is one of two plants being built by the Ohio Valley Electric Corporation to supply electric power to the Atomic Energy Commission's new $1^1/_4$ billion Portsmouth (Ohio) diffusion plant. See also frontispiece on page 208 of this issue.

while Unit 1 at Kyger Creek was ahead of schedule by more than a month. These two units will be followed by nine additional and similar machines, bringing OVEC's total generating capability to 2,200,000 kw when the final unit of the series of 11 is completed in early 1956.

Ground was broken at both Clifty Creek and Kyger Creek in December, 1952. Clifty Creek, located on the Ohio River, 50 miles downstream from Cincinnati, will have six 200,000-kw units, or a total capability of 1,200,000-kw—greater than any steam-power plant operating today. It will represent an investment of about \$175 million upon its completion. Kyger Creek, located on the Ohio about midway between Parkersburg and Huntington, W. Va., will have five units of the same size, totaling 1,000,000 kw. It will cost about \$145 million upon completion. All units will operate at a steam pressure of 2000 psi and steam temperature of 1050 F and are expected to burn a total of about 7 $^1/_2$ million tons of coal per year.

The tremendous bulk of the power generated by the two plants will be fed via double-circuit 330,000-volt transmission lines—highest voltage lines in the nation—to the AEC plant. At the latter, the electric energy will be utilized in the large-scale separation of the isotope U-235 from natural uranium, in which U-235 appears only to the extent of 7/10 of 1 per cent—a multistage process.

Fig. 7 **Shown here is the giant forging press which recently began production at the Cleveland, Ohio, works of Aluminum Company of America. Capable of exerting 8000 tons pressure for forging aluminum into vital aircraft parts, the press rises 38 ft above the floor and weighs almost 4,000,000 lb.**

8000-Ton Forging Press

A forging press, weighing almost 4,000,000 lb and capable of applying 8000 tons pressure for forging metal, has begun operation at Aluminum Company of America's Cleveland, Ohio, works. Previously at this location, Alcoa had presses with capacities of 1500 tons, 3000 tons, and 15,000 tons, respectively, with no intermediate-size unit available. The gap in press size quite often placed limitations on forging design.

The size of the press is indicated by its over-all height of 55 ft, with 38 ft above floor level. The die area in which forgings can be produced is 11 $^1/_2$ ft long and 4 $^1/_2$ ft wide.

Large precision aircraft forgings of the close-tolerance low-draft type will be an important product of the press. The large die area will allow production of big forgings not requiring the tremendous pressures of the 15,000-ton press now in production or the 35,000 or 50,000-ton presses which will also be in operation in Cleveland this year.

The new press will also offer greater capacity for the production of magnesium and titanium forgings. It will be valuable too for the production of nonmilitary forgings such as automobile and truck wheels.

Among the unusual features of the 8000-ton press are its departure from conventional tie-rod design to increase rigidity and accuracy and its large die area.

Most big hydraulic presses are held together by a number of big-threaded tie rods which act like giant bolts to prevent the press from pushing itself apart as pressure is applied to its dies. The 8000-ton press, which was designed and built by United Engineering and Foundry Company, is put together as though it were one giant rigid steel casting. Actually the unit is composed of a number of giant castings joined to act as one.

The big castings (seven of them weigh over 400,000 lb each) are held together by unique shrink links. Rings are heated and fit over lugs on each of the big castings. As they cool and contract over the lugs they hold the castings firmly together.

This one-casting rigidity permits extremely accurate guiding of forging dies and allows close tolerance work. The press weighs 3,900,000 lb, about twice the weight of a conventional single-cylinder 8000-ton press. The rigidity makes it possible to produce difficult unsymmetrical forgings without destroying the alignment of the press or impairing forging tolerances.

The press has a working stroke of 6 ft with a 3-in. per sec pressing speed. The controls on the press are portable and can be relocated to allow the operator the best vantage point for controlling operation. Hydraulic pressure to operate the press is supplied by three 700-hp pumps and stored in a 600-gal accumulator at 4500 psi.

The press installation includes two billet-heating furnaces.

Aluminum Reduction Cell

The largest reduction cell ever operated in a commercial line producing aluminum is used in the two reduction plants recently built by Reynolds Metals Company, to meet the increased demands for primary aluminum. These two facilities are the San Patricio Plant, near Corpus Christi, Texas, with a rated capacity of 160,000-000 lb of aluminum per year, and the Robert P. Patterson Plant at Arkadelphia, Ark., with a capacity of 110,000,000 lb yearly.

Experimental development on this cell was nearing

completion at the outbreak of the Korean War. It is from two to six times the size of other units now in use in this country. Each unit has a daily production of approximately 2000 lb of high-grade aluminum. Each must be fed at a daily rate of 4000 lb of alumina (aluminum oxide) and approximately 1000 lb of carbon-anode material.

Fig. 9 Over-all view of potline at Reynolds Metals new Robert P. Patterson aluminum reduction plant at Arkadelphia, Ark. Each large pot produces 2000 lb of high-grade aluminum daily. Each cell requires 4000 lb of alumina and 1000 lb of carbon-anode material daily.

This reduction cell is of the Soederberg type. It requires over 90,000 lb of steel in the fabrication of the shell and superstructure frame. The lower half of the cell makes up the cathode and consists of a fabricated box approximately 12 ft wide, 38 ft long, and 3 ft deep into which over 60,000 lb of carbon lining is rammed, leaving a formed cavity 16 in. deep and somewhat smaller than the dimensions of the shell. In this cavity is held the molten aluminum as it is produced as well as the electrolyte material used in the process. As electrolyte temperature must exceed 1700 F, over 16,000 lb of alumina is used as insulation between the steel shell and carbon lining to prevent excessive heat loss. Imbedded into the carbon lining are approximately 130 steel bars, $2^1/_2$ in. in diam and about 4 ft long. These are contacts for the large quantities of current required in the process.

Supported from insulated brackets on the cathode is a structural frame that supports the anode in the electrolytic material in the cavity of the cathode. The anode is a carbon block over 5 ft wide and nearly 33 ft long. The structural frame also carries the jacks and other mechanism required to adjust the level of the anode with respect to the cathode. The anode is lowered continuously as it is decomposed in the electrolytic process at the bottom and replenished from the top.

To form the positive electrical contact at the anode, approximately 70 contact pins, 3 in. in diam, are imbedded in the carbon mass of the anode. Large quantities of electric power are required for the operation of this cell. Aluminum bus bars with cross-sectional area of over 500 sq in. and capable of carrying over 125,000 amp are used to carry power to and from the cell. Each cell requires more than 30,000 lb of aluminum bus and approximately 16,000 lb of copper bus for this purpose.

The cells are arranged for a series electrical circuit with the current flowing through the bus to the anode of the first cell, through the electrolyte and metal pad, and on into the cathode. From the cathode it flows through the bus to the anode of the second cell and so on down the line.

Normally, the line consists of 160 cells with 80 cells in each of two parallel buildings. In the first, the lower moves away from its source; in the second, it is returned to its source. Each building is made of steel frame with aluminum roofing and siding, is more than 1800 ft long, and covers over 2 $^1/_2$ acres.

The power source of such a line must have a direct-current capacity of approximately 1000 kw, which is enough to supply a city of 300,000 population.

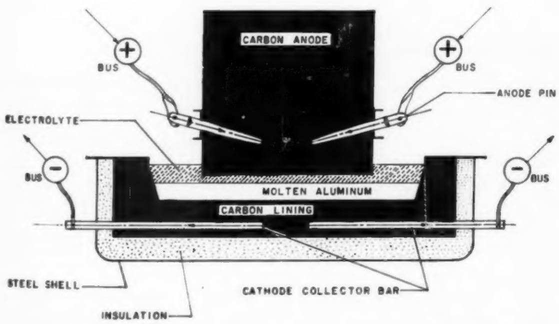


Fig. 8 Diagram of Soederberg-type aluminum reduction cell

Giant Steel Press

A PUSH-BUTTON giant steel press, weighing $1^1/_2$ million lb, capable of straightening steel plate nearly 2-ft thick, was unveiled at the Lukens Steel Company in Coatesville, Pa., recently by the Clearing Machine Corporation of Chicago, Ill., builders of the press.

The new press has a movable pressing head with a capacity of 5000 tons pressure. It is the largest movable-head flattening press ever built, according to officials of Clearing, a division of the U. S. Industries, Inc.

The press will be used principally for straightening armor plate prior to delivery to shipyards. In addition, it will be used by the Lukens Steel Company for commercial purposes.

The press makes easy work of flattening plate weigh-

Fig. 10 This $1^1/_2$ million-lb press is now straightening steel plate at the Lukens Steel Company in Coatesville, Pa. The press has a movable pressing head with a capacity of 5000 tons pressure. Built by Clearing Machine Corporation of Chicago, Ill., the unit can straighten plate nearly 2 ft thick. Shown is a steel plate, weighing between 15 and 20 tons, being straightened after leaving the rolling mill.

ing more than 50 tons. Yet, the sensitivity of the controls permits the straightening of a steel plate 20 in. thick, 50 in. wide, and 14 ft long to within $^1/_2$-in. tolerance.

The unit, about the height of a two-story building, covers a 400-ft area of floor space. The press is electrically controlled by one man from a "pulpit" or control panel, and derives its pressure from a hydraulic system.

A unique feature of the press is the ability of the pressing head to be moved from right to left a total of 160 in. In addition, two motorized cars on either side of the press can shift the steel plate backward and forward so that any area of the plate can be flattened.

Incorporated in the bed of the press are 32 lifting pins for raising or lowering the length of plate. The bolster plate, the area on which the steel plate is placed to be flattened, is more than 3 ft thick in order to carry the tremendous pressure.

Another feature of the press is its design to withstand eccentric loading, in other words, permitting the press to withstand pressure exerted at off-center points.

Submerging Base

The U. S. Army Corps of Engineers has built a new arctic base deliberately designed to sink slowly beneath the surface of the Greenland polar icecap. The base was requested by the Department of Air Force in relation to its arctic-defense responsibilities in the latter part of 1952. The base is located some miles closer to the North Pole than Thule.

The polar cap, estimated to be 10,000 ft deep in places, will not support standard buildings since it is too soft and churns in a packing action which tends to pull structures down to its depths.

Army engineers, therefore, employed the submarine pressure-hull principle and built the buildings of metal culverts 18 ft in diam and of varying lengths. The tubes are hooked together at the ends and with interconnecting passageways.

Like a ship, the over-all structure is balanced to go down into the snow on an even keel at the rate of several feet a year.

It is the first time in history that a permanent structure has been built successfully on the icecap.

Personnel move in and out when necessary through submarinelike escape hatches which can be lengthened as the structure descends.

The insides of the culverts are squared into long rooms with braces to support the weight of the structure and to withstand the pressure of snow and ice on the sides and on top as the sections move lower into the icecap.

The tubes are carefully insulated against cold as low as minus 72 F. Heating plants maintain inside temperatures at plus 72 F.

The buildings are equipped with sleeping quarters, mess hall, recreation room, kitchen, clinic, communication facilities, and fuel, food, and water for an indefinite period.

100 G-E Gas Turbines

Manufacture of the General Electric Company's 100th combustion gas turbine has been announced by John P. Keller, general manager of the company's gas-turbine department.

Of the 100 units manufactured by G-E, Mr. Keller said, 97 are now installed and operating in widely separated areas. Units now in operation have totaled over 500,000 hr of service, or the equivalent of one machine operating night and day for over 55 years.

Of the 97 units, 40 are natural-gas pipe-line pumping units, 27 are used in locomotives, 10 are installed on a platform in Lake Maracaibo, Venezuela, to maintain

pressure in oil fields, 17 are used for electric-power generation by electric-utility companies in the United States, two are used to generate electric power at an oil plant in Venezuela, and one is used in an oil refinery in the United States.

Now that gas turbines have completed the first stage of commercial application, Mr. Keller predicts new and greater applications for these machines in industry. He cited an order received by the company for a gas-turbine installation in a Liberty ship of the country's "Mothball" fleet as an example of one new field of application.

Because of the adaptability of the gas turbine to meet power demands of rapidly expanding industry, Mr. Keller said more and more gas turbines will be used, many of them to complement steam turbines.

The gas turbine can perform three basic jobs in industry, he said. In addition to supplying mechanical power to turn generators, blowers, and compressors, it can supply compressed air taken from its compressor, and it can supply heated exhaust gas. Heated exhaust gas may be used to make process steam in a waste-heat boiler, or for combustion air in a boiler, or for heat used directly in industrial processes.

KEL-F Elastomer

The first information on the properties, compounding, vulcanization, and fabricating of its KEL-F fluorocarbon elastomer has been revealed by The M. W. Kellogg Company.

Developed in co-operation with the Office of the Quartermaster General, U. S. Army, the elastomer will be available commercially early this year. Until now all of the elastomer has been used for experimental purposes.

Recent tests indicate that this unique synthetic rubber will be useful in fields requiring: (1) Extreme resistance to oxidants such as fuming nitric acid, oleum, 90 per cent hydrogen peroxide, ozone, oxygen, and weather; (2) thermal stability up to 400 F; (3) chemical resistance to oils at high temperature, excluding diester types, but including sour crudes, sulphur-bearing extreme-pressure lubricants, and silicones; and (4) those applications requiring very low absorption, including electrical insulation.

A number of items to meet these specifications have been fabricated and tested, including: Hose, tubing, diaphragms, gaskets, O-rings and seals, tank linings and fuel cells, corrosion-resistant paints and sealants, and acid-resistant boots, gloves, as well as protective clothing.

Specifically, KEL-F elastomer has excellent resistance to strong oxidizing mineral acids, peroxides, alkalies, titanium tetrachloride, alcohols, aliphatic solvents, some chlorinated solvents, hydraulic fluids, silicone oils, and sulphur-bearing extreme-pressure lubricants.

It will withstand immersion in white fuming nitric acid for an extended period. All other available rubbers will disintegrate within a matter of minutes in this acid.

The exact chemical formula of KEL-F elastomer was not announced, but it was revealed that the synthetic rubber is a fully saturated fluorocarbon polymer containing more than 50 per cent fluorine by weight. Elasticity is obtained by incorporation of methylene groups in the normally rigid, highly fluorinated polymer chain.

According to Kellogg, x-ray diagrams have shown that the polymer is amorphous at temperatures as low as -40 C. On being stretched to 300 per cent, typical fiber diagrams are observed, indicating susceptibility to orientation and crystal formation.

Thermal stability is shown by the fact that there was no evidence of chain scission or halogen loss after prolonged exposure at 400 F.

Among chemical and heat-resistant rubbers, KEL-F elastomer is notable for its high tensile strength (2000–3500 psi), good extensibility (400–600 per cent), and good tear strength (150–400 ppi). Compression-set measurements of the compounded material show values as low as 5 per cent at 77 F and 30 per cent at 212 F.

The Kellogg announcement said that its fluorocarbon elastomer can be compounded readily, mixed, molded, and extruded, using standard rubber-processing equipment.

However, because it is a fully saturated fluorocarbon, it is not readily vulcanized by normal rubber curatives. It can be vulcanized with the organic peroxides, polyisocyanates, polyamines, and isocyanate-amine combinations. Although the chemistry of KEL-F elastomer vulcanization is not fully understood, the marked increase in strength and solvent resistance after cure indicates that the elastomer has undergone a chemical change, producing a network or cross-linked type of structure.

KEL-F elastomer will be available from The M. W. Kellogg Company as a white spongy crumb or in the form of compressed sheets.

Experimental Cars

Seven new experimental cars and a specially designed truck are featured in the General Motors Motorama of 1955 (see pages 250 and 251).

General Motors President Harlow H. Curtice calls the eight vehicles "one of the most impressive groups of experimental cars to appear on the automotive scene since General Motors introduced the dream-car idea to the industry 17 years ago."

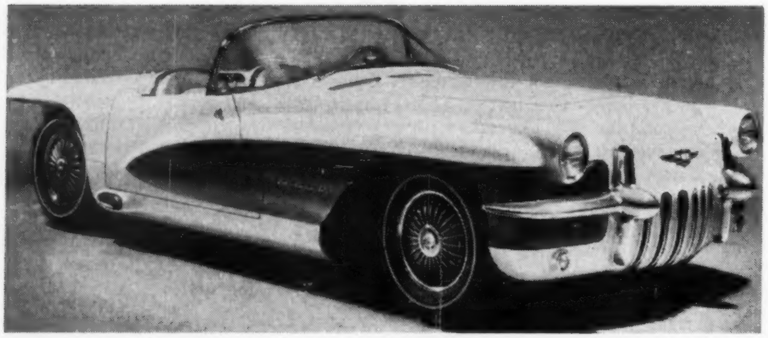
"The 1955 experimental vehicles with their advanced design features will give us a chance to present new ideas to a public that is more automobile conscious than ever before in history," Mr. Curtice says.

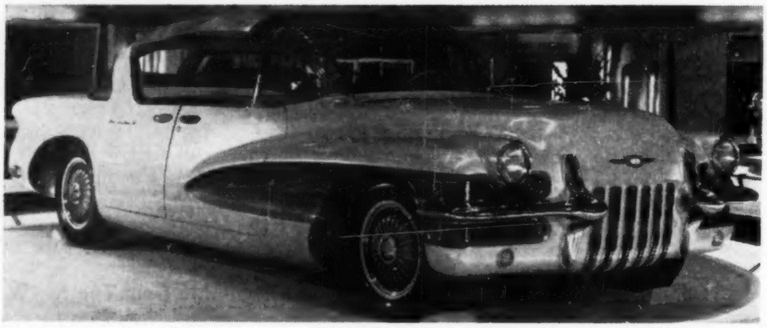
One of the high lights is the L'Universelle, a radio-equipped package-delivery truck styled along passenger-car lines. Nearly a foot lower than conventional panel trucks, L'Universelle has fully as much load capacity as larger trucks and is designed so as to be adaptable for any one of many uses.

Although the new dream cars include one 2-passenger sports coupe, the emphasis is on more passenger room. Besides the 2-passenger coupe, the group includes two 6-passenger and four 4-passenger cars.

All of the cars and trucks except the Cadillac Eldorado Brougham are of reinforced fiberglas construction. The Eldorado is of steel construction.

Now on tour of numerous cities in the United States, the Motorama appeared in New York, N. Y., January 20 to 25, and in Miami, Fla., February 5 to 13. Future appearances for the Motorama are scheduled for Los Angeles, Calif., March 5 to 13; San Francisco, Calif., March 26 to April 3; and Boston, Mass., April 23 to May 1.

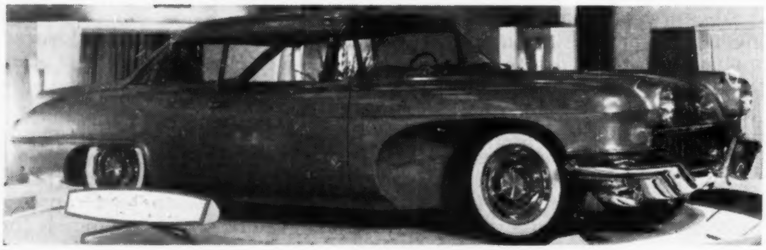




LaSalle II—a 2-door, 2-passenger sports coupe (*top*) and LaSalle II, a 4-door, 6-passenger sedan (*bottom*) are powered by fuel-injection type V-6 engines capable of developing 150 hp. Both are minimal-sized cars. The sports coupe has an over-all length of 151.7 in.; width, 65 in.; height, 42.8 in. at top of windshield, $33\frac{1}{4}$ in. at the cowl; road clearance, 5.1 in.; wheelbase, 99.9 in.; tread, 52 in. front, 50 in. rear. Tires are 6.40 × 13 in. The wheels are of cast aluminum with radiating spokes which serve to dissipate heat from the integral brake drums. Exhaust gases are piped through elliptical side-frame members and through the lower section of the body in titanium ports just ahead of the rear wheels. The LaSalle II sedan is 180.2 in. over-all length; width, 69.5 in.; height, 49.8 in.; road clearance, 5 in.; wheelbase, 108 in.; tread, 52 in. front, 52 in. rear; tire size, 6.40 × 13 in. The floor, body sills, engine supports, and body shell are fused into one integral structure. The body sill also serves as a housing for the exhaust pipe and muffler.

EXPERIMENTAL CARS . . .

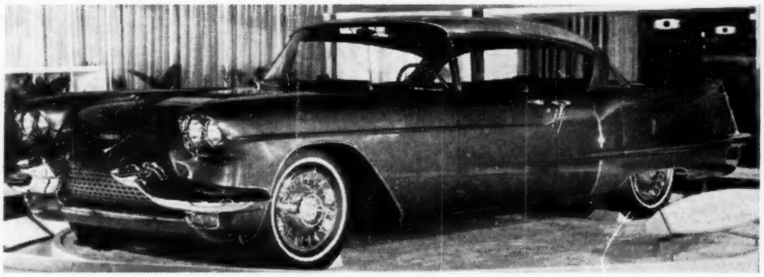
. . . *shown at General Motors Motorama*

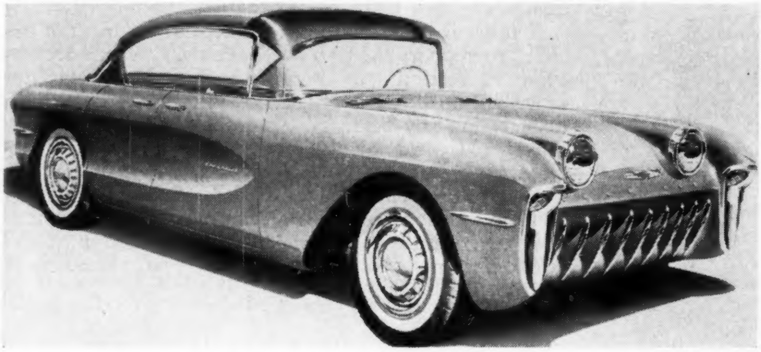


Pontiac Strato-Star—a 4-door, 6-passenger hard-top coupe powered by a 250-hp Strato-Streak V-8 engine with 4-barrel carburetor; over-all length, 202.5 in.; width, 75.6 in.; height, 53.1 in.; road clearance, 6 in.; wheelbase, 120 in.; tread, 58.5 in. front, 59 in. rear. Aircraft-type intake scoops above the head lamps serve to vent passenger and driver areas. The wheels are a deep-draw section of chrome with a brake-cooling air-intake area of turbine-impeller wheel design.

Buick Wildcat III—a 2-door, 4-passenger convertible powered by a 280-hp Buick V-8 engine with a 9:1 compression ratio and equipped with four carburetors; over-all length, 190.5 in.; width, 72 in.; height, 51.75 in.; road clearance, 6 in.; wheelbase, 110 in.; tread, 60 in. front and rear. The hood slopes toward the front of the car, increasing immediate forward vision. Air intakes near the front bumpers and on the rear fenders serve to provide brake cooling. All seats are of the bucket type.

Cadillac Eldorado Brougham—a 4-passenger 4-door sedan powered by a 280-hp Cadillac V-8 engine; length, 209.6 in.; width, 77.5 in.; height 54.4 in.; road clearance, 6 in.; wheelbase, 124 in.; tread, 60 in. front, 61 in. rear. The four individual seats are tailored for individual-passenger comfort. The front seats pivot out for ease of entrance and exit. There are two compartments for driver and front-seat passenger, one on the control panel and the other between the two front seats.

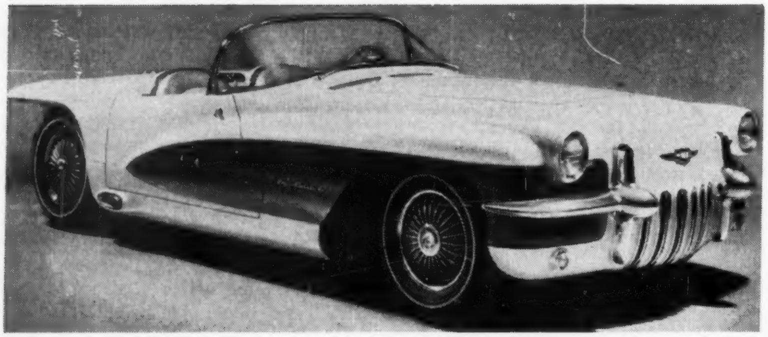




Chevrolet Biscayne—a 4-door, 4-passenger sedan powered by a 215-hp modified turbofire V-8 high-compression engine with 4-barrel carburetor; over-all length, 185.7 in.; width, 69 in.; height, 52.5 in.; road clearance, 6 in.; wheelbase, 115 in.; tread, 56 in. front, 56.8 in. rear. The head lamps are located between projectile fenders which house parking lamps. Aerodynamic rear-end design eliminates conventional fender contours. Race-car-type air scoops are below windshield on the hood. Front seats pivot for easy entrance and exit. Seats also are closer to door and the floor is dropped to the bottom level of the frame.

Oldsmobile 88 Delta—a 2-door, 4-passenger hardtop coupe powered by a 250-hp Rocket engine; over-all length, 201 in.; width, 74 in.; height 53 in.; road clearance, 6 in.; wheelbase, 120 in.; tread, 59 in. front, 58.5 in. rear. An aircraft-type intake scoop delivers air to the front brakes. The hood extends the full lateral distance between the fender-crown lines and this entire panel raises, thus eliminating, in effect, the hood cut lines. The rear end has a long, wide, and low deck. A horizontal bumper blade wraps around the entire rear end of the car. Dual exhaust stacks serve as rear-bumper guards.

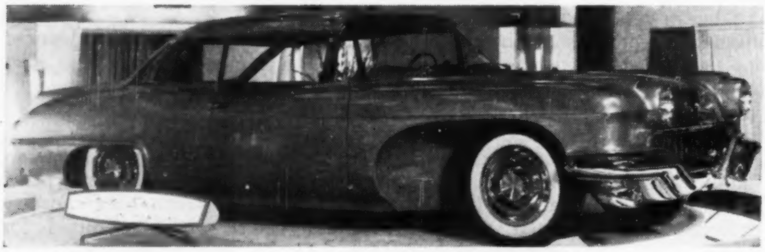
L'Universelle—a package-delivery truck designed along passenger-car lines and adaptable to many uses. The truck is powered by a V-8 engine of 288 cu in. developing 180 hp, and is located beneath and behind the driver and transmits power to the differential through an inverted Hydra-Matic transmission. A deDion drive to the front wheels permits them to move up and down independently of the frame. Wheelbase is 107 in.; length, 188 in.; height, 67.6 in.; tread, 62 in.; interior load-compartment width, 67 in.; interior height for loads, 53.62 in.; interior load length at floor, $99^1/_2$ in.; load capacity, 170 cu ft; load floor height, 13 in. The truck offers full-width passenger-car seating. Absence of hood in front offers widest possible vision. Loading doors are located on either side and in the rear.



LaSalle II—a 2-door, 2-passenger sports coupe (*top*) and LaSalle II, a 4-door, 6-passenger sedan (*bottom*) are powered by fuel-injection type V-6 engines capable of developing 150 hp. Both are minimal-sized cars. The sports coupe has an over-all length of 151.7 in.; width, 65 in.; height, 42.8 in. at top of windshield, $33^1/_4$ in. at the cowl; road clearance, 5.1 in.; wheelbase, 99.9 in.; tread, 52 in. front, 50 in. rear. Tires are 6.40 × 13 in. The wheels are of cast aluminum with radiating spokes which serve to dissipate heat from the integral brake drums. Exhaust gases are piped through elliptical side-frame members and through the lower section of the body in titanium ports just ahead of the rear wheels. The LaSalle II sedan is 180.2 in. over-all length; width, 69.5 in.; height, 49.8 in.; road clearance, 5 in.; wheelbase, 108 in.; tread, 52 in. front, 52 in. rear; tire size, 6.40 × 13 in. The floor, body sills, engine supports, and body shell are fused into one integral structure. The body sill also serves as a housing for the exhaust pipe and muffler.

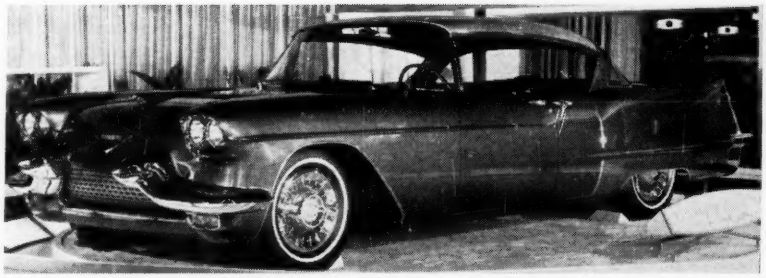
EXPERIMENTAL CARS . . .

. . . *shown at General Motors Motorama*

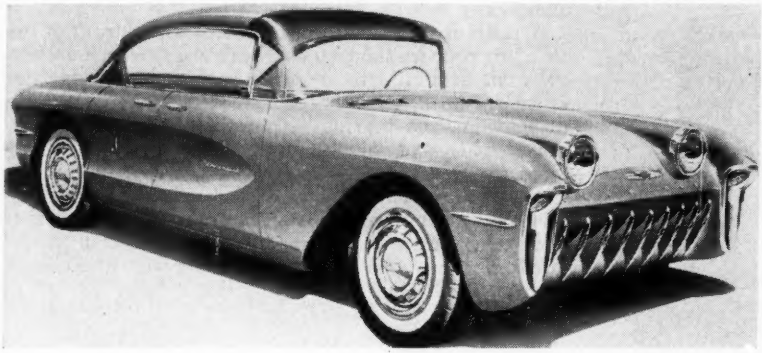


Pontiac Strato-Star—a 4-door, 6-passenger hardtop coupe powered by a 250-hp Strato-Streak V-8 engine with 4-barrel carburetor; over-all length, 202.5 in.; width, 75.6 in.; height, 53.1 in.; road clearance, 6 in.; wheelbase, 120 in.; tread, 58.5 in. front, 59 in. rear. Aircraft-type intake scoops above the head lamps serve to vent passenger and driver areas. The wheels are a deep-draw section of chrome with a brake-cooling air-intake area of turbine-impeller wheel design.

Buick Wildcat III—a 2-door, 4-passenger convertible powered by a 280-hp Buick V-8 engine with a 9:1 compression ratio and equipped with four carburetors; over-all length, 190.5 in.; width, 72 in.; height, 51.75 in.; road clearance, 6 in.; wheelbase, 110 in.; tread, 60 in. front and rear. The hood slopes toward the front of the car, increasing immediate forward vision. Air intakes near the front bumpers and on the rear fenders serve to provide brake cooling. All seats are of the bucket type.



Cadillac Eldorado Brougham—a 4-passenger 4-door sedan powered by a 280-hp Cadillac V-8 engine; length, 209.6 in.; width, 77.5 in.; height 54.4 in.; road clearance, 6 in.; wheelbase, 124 in.; tread, 60 in. front, 61 in. rear. The four individual seats are tailored for individual-passenger comfort. The front seats pivot out for ease of entrance and exit. There are two compartments for driver and front-seat passenger, one on the control panel and the other between the two front seats.



Chevrolet Biscayne—a 4-door, 4-passenger sedan powered by a 215-hp modified turbofire V-8 high-compression engine with 4-barrel carburetor; over-all length, 185.7 in.; width, 69 in.; height, 52.5 in.; road clearance, 6 in.; wheelbase, 115 in.; tread, 56 in. front, 56.8 in. rear. The head lamps are located between projectile fenders which house parking lamps. Aerodynamic rear-end design eliminates conventional fender contours. Race-car-type air scoops are below windshield on the hood. Front seats pivot for easy entrance and exit. Seats also are closer to door and the floor is dropped to the bottom level of the frame.

Oldsmobile 88 Delta—a 2-door, 4-passenger hardtop coupe powered by a 250-hp Rocket engine; over-all length, 201 in.; width, 74 in.; height 53 in.; road clearance, 6 in.; wheelbase, 120 in.; tread, 59 in. front, 58.5 in. rear. An aircraft-type intake scoop delivers air to the front brakes. The hood extends the full lateral distance between the fender-crown lines and this entire panel raises, thus eliminating, in effect, the hood cut lines. The rear end has a long, wide, and low deck. A horizontal bumper blade wraps around the entire rear end of the car. Dual exhaust stacks serve as rear-bumper guards.

L'Universelle—a package-delivery truck designed along passenger-car lines and adaptable to many uses. The truck is powered by a V-8 engine of 288 cu in. developing 180 hp, and is located beneath and behind the driver and transmits power to the differential through an inverted Hydra-Matic transmission. A deDion drive to the front wheels permits them to move up and down independently of the frame. Wheelbase is 107 in.; length, 188 in.; height, 67.6 in.; tread, 62 in.; interior load-compartment width, 67 in.; interior height for loads, 53.62 in.; interior load length at floor, $99^1/_2$ in.; load capacity, 170 cu ft; load floor height, 13 in. The truck offers full-width passenger-car seating. Absence of hood in front offers widest possible vision. Loading doors are located on either side and in the rear.

European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

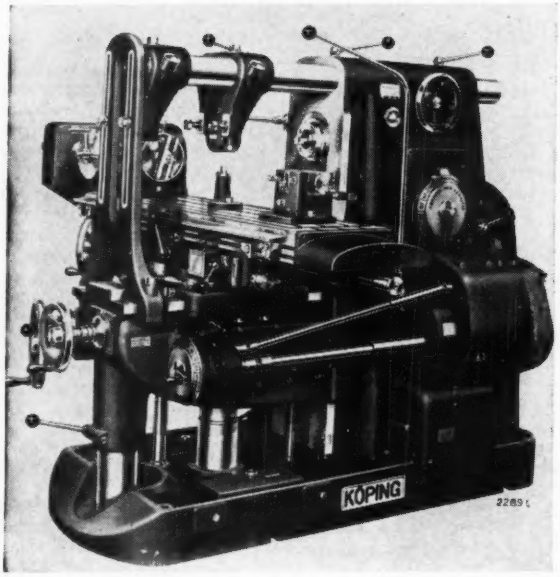


Fig. 1 Köpings Mekaniska Verkstads AB universal milling machine

Swedish Milling Machine

The Swedish firm of Köpings Mekaniska Verkstads AB—who, incidentally, will celebrate their centenary this year—exhibited at Milan a universal milling machine of notably rigid design. It is illustrated in Fig. 1.

The working surface of the table measures 1500 mm by 360 mm and the height of the spindle above the table is 450 mm. The baseplate and column are cast in one, being widened at the base to accommodate the driving motor, which may be of either 13.5 or 19 hp, according to requirements and the model selected. The baseplate also contains the tanks for the coolant and the lubricating oil, and the oil pump is located inside the column.

The drive is by V-ropes, the tension being adjusted by moving the motor vertically on its mounting. Separate drives are provided for the milling spindle and the quick-power traverse of the table. The driving gears are entirely enclosed; they are of hardened alloy steel, and the high-speed gears have ground teeth. The spindle speeds are controlled by a lever on the right side of the column, and a dial gives a direct reading of the speed in use.

Another dial shows the feed gears that are in use, which also are set by a lever on the right of the column.

A pillar is provided for attachment to the front of the slide, to support the two overhead arms, which are circular in section. By removing the aluminium arm brace, the milling arbors can be readily changed without dismantling any bearings. The table has a hand-feed, power-feed, and quick-power traverse in all directions.

Each feed is controlled by a separate lever for engaging and disengaging, and it is a feature of the design that these levers are always pushed in the direction of the desired motion. All the feed screws are fitted with micrometer dials.

Low-Headroom Loader for Tunneling

At the Public Works and Municipal Services Exhibition held in London, England, in November, 1954, the Atlas Diesel Company, of Stockholm, Sweden, showed a compact mechanical loader intended for use in mining,

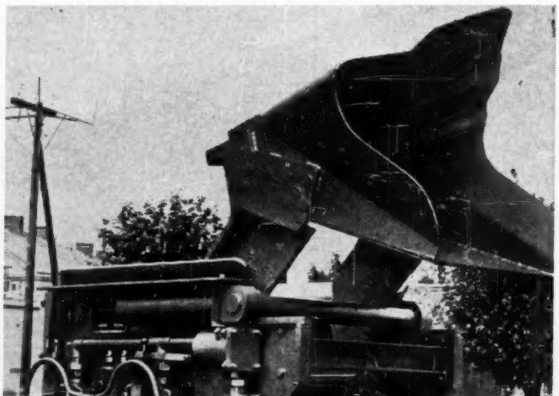


Fig. 2 LM-200 low-headroom loader for use in mining, tunneling, and other places having limited space

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

tunneling, and similar situations where headroom is limited and where it is necessary to discharge to trucks behind the machine. It is illustrated in Fig. 2. The LM-200 loader, as it is designated, is operated by compressed air at a pressure of 6 atm (85 psi) and has a bucket capacity of 0.6 cu yd. It can be adapted to run on track from 750 mm to 900 mm gage (30 in. to 35 in.) and is propelled by a motor of 22 hp. The bucket-operating motor develops 28 hp. The minimum headroom required is 2950 mm (9 ft 8$^1/_4$ in.).

Denny-Brown Ship Stabilizers

Some interesting experiences in the mechanical stabilization of ships were recalled by Sir William Wallace, chairman and managing director of Brown Brothers and Company, Limited, of Edinburgh, in a paper which he gave in January to the Institution of Engineers and Shipbuilders in Scotland. Sir William was associated with Sir Maurice Denny, of the shipbuilding firm of William Denny and Brothers, Limited, in the development of the Denny-Brown ship stabilizer, which was first fitted in a channel steamer in 1936, extensively employed in British naval-escort vessels during the second world war, and has since been fitted in the largest passenger ships built

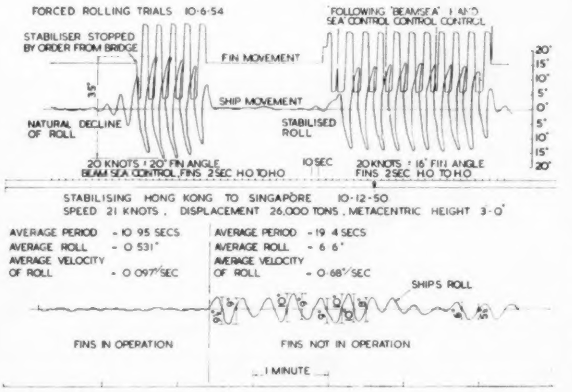


Fig. 3 Records of action of Denny-Brown ship stabilizers in P. & O. liner *Chusan* on a normal voyage between Hong Kong and Singapore

in British shipyards, including the new Cunard liner, *Saxonia*. It is understood that an installation is in hand for the *Queen Elizabeth*. The principle of the Denny-Brown stabilizer is the employment of projecting fins, like the hydroplanes of a submarine but situated at about mid-length of the ship, which can be given a rapid alternation of upward and downward inclinations to counteract rolling of the hull. In fine weather, and in harbor, they are retracted within the hull. For extending and retracting the fins, and for tilting them when extended, hydraulic mechanism is employed. The tilting action, which reverses with great rapidity (in 1 to 2 sec, according to the rolling period of the ship, and through a maximum angle of 40 deg), is controlled by two small gyroscopes, one measuring the angular velocity of rolling and the other the angular displacement.

The signals from the gyroscopes energize a sensitive hydraulic-motor unit which operates a cam-and-lever system attached to the regulating valve of the hydraulic-control cylinder, which actuates the main tilting pumps.

Sir William mentioned that the total amplification in torque, from gyroscope to fin shaft, in a stabilizer of the size fitted in the P. & O. liner, *Chusan* (24,000 tons gross) is approximately 500,000,000:1. For testing purposes, the stabilizers can be used to make the ship roll in a flat calm. Diagrams taken on board the *Chusan* under such conditions, and on a normal voyage between Hong Kong and Singapore, are reproduced in Fig. 3.

In the latest design of Denny-Brown stabilizer, the rear edge of the fin is formed as a hinged flap, with a breadth about one quarter of the full chord of the fin, and only this portion is tilted. This makes possible a much stronger and lighter construction of the fin.

Among the "experiences" recounted by Sir William in his paper were some instances in which ships lost fins at sea as the result of excessive stresses in the fin shafts; but redesigning of the affected parts, using a fabricated-steel fin on a cast-steel socket carried on the fin shaft, has greatly reduced the weight and the concentration of stress.

In the P. & O. liner, *Iberia*, the cast-steel fins weigh 21 tons each, but corresponding fins of the new design only about 12 tons.

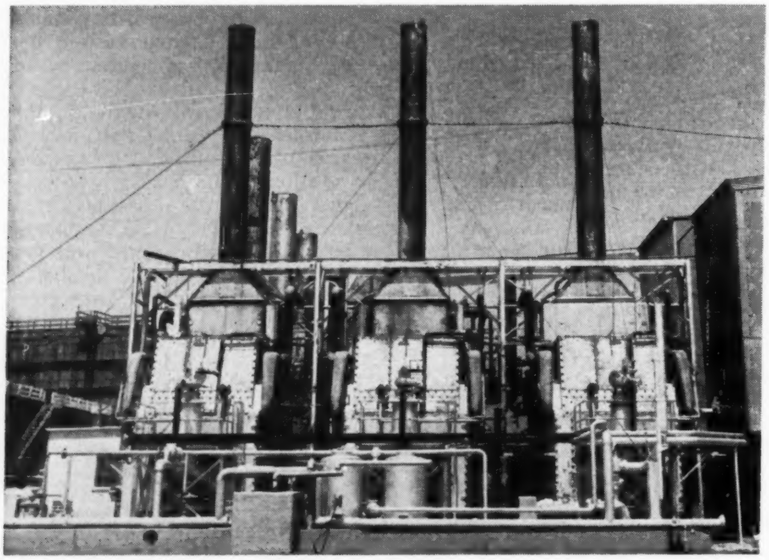
Inventors and Inventions

Sir Edward Appleton, F. R. S., the discoverer of the Appleton Layer, in delivering the Andrew Laing Lecture to the North-East Coast Institution of Engineers and Shipbuilders at Newcastle-on-Tyne, England, on Dec. 10, 1954, devoted a part of his discourse to, as he put it, "attempting to identify the characteristics of the inventive step."

Such a step, Sir Appelton suggested, must contain something more than merely deductive reasoning; the impact of an invention on the minds of others, skilled in the art, should engender surprise. "The best type of invention," he went on, "is only understood after it has been explained. Inventors must, of course, first identify a practical need; but, beyond that, they must be people who, while they may have been told, don't believe that things can't be done. Inventors are people who seem to take pleasure in rejecting, at least for a time, accepted laws and theories, though the best of them may make many experiments in their minds for every one they make on the bench. The more pedestrian of the inventor class try everything, however unpromising, in an effort to get results. In the case of the most brilliant, intuition is highly developed. An invention results from an adventure in a single mind. Teams don't make inventions. Also, I may remark, patent-consciousness among some of the members of a team can work havoc with effective collaboration." The Andrew Laing Lecture was established to commemorate Andrew Laing (1856–1931), general manager and director of the Wallsend Slipway and Engineering Company, who designed the propelling machinery of the Cunard Line's first *Mauretania*, in collaboration with the Parsons Marine Steam Turbine Company.

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings



Marine-type boilers shown in service at the Salt River Power District's Cross Cut Steam Plant. Placed in operation in July, 1947, the boilers are a permanent part of the station's steam-generating capacity. They are Babcock & Wilcox boilers of the single-drum sectional-header design.

Steam Power Generation

Land-Based Operation of Marine Boilers, by E. T. Eyring, Mem. ASME, and J. O. Rich, Assoc. Mem. ASME, Salt River Power District, Phoenix, Ariz. 1954 ASME Annual Meeting paper No. **54—A-218** (multilithographed; available to Oct. 1, 1955).

This paper describes how the combination of heavy load growth immediately after World War II and an extreme drought forced a company to put in for the second time steam-generating equipment. Since it was difficult to get quick deliveries in the post-war days, a U. S. Navy mobile steam plant was leased in 1946.

Initial operating days were made extremely difficult because of low-quality fuel oil that slagged the fireside of the tubes and forced outages for cleaning every 8 to 10 weeks. When the boilers were converted to fire natural gas, the slagging problem disappeared. From the spring of 1949 through the summer of 1952, the boilers were operated continuously except during annual maintenance periods.

The authors feel the operation of these marine units was as satisfactory and reliable as any of the stationary steam-generating equipment operated by the Salt River Power District.

Four Years' Stationary Operation of Marine Boilers, by J. H. Colby, Assoc. Mem. ASME, Diamond Alkali Company, Deer Park, Texas. 1954 ASME Annual Meeting paper No. **54—A-219** (multilithographed; available to Oct. 1, 1955).

Four oil-fired divided-furnace marine boilers originally designed for U. S. Navy destroyers, class 692, were purchased as war surplus to meet a large post-war increase in paper and board production capacity of the Texas division of the Champion Paper and Fibre Company.

The author gives the details of the boilers and the alterations they underwent. One of these was conversion to natural-gas firing. A second alteration was in instrumentation to make the units as fully automatic as possible. Further, a top-flight water-treatment program was set up to give the best possible water in the boiler despite heavy make-up requiring blowdown approaching 16 per cent or so.

It was reported that these marine boilers have proved a dependable and economic source of steam. They have been utilized 70 per cent of the time but available 98 per cent. Steam cost for the past year has been 25 cents per million Btu and $28^1/_2$ cents per 1000 lb of steam. Natural gas has cost 13 cents per million Btu and represents most of the steam cost. Chargeable labor and supervision amounted to only 3 per cent of the cost; maintenance about 1 per cent; and power, depreciation, taxes and overhead, the remainder.

An Industrial Application of a Marine-Type Power Plant, by T. J. Judge, Mem. ASME, International Paper Company, Mobile, Ala. 1954 ASME Annual Meeting paper No. **54—A-220** (multilithographed; available to Oct. 1, 1955).

Experiences with a 4925-kva turbine generator and auxiliaries, two 32,000-lb per hr, 450-psig, 750-F boilers, comprising a marine-type electric-generating plan installed in 1948, are discussed. Results were surprisingly good, it is reported.

Many of the outstanding design features highly praised by the operators were adopted in the specifications for subsequent power equipment. The last six years' operating record backs up the operator's reactions since the units have performed at a remarkably high availability and with very low maintenance.

The author gives a report on the more important of the operating difficulties. In almost all instances the difficulties were readily overcome. Any major repairs could be held off or worked into the scheduled shutdown periods.

Effect of Fly-Ash Characteristics on Collector Performance, by H. J. White, Research Corporation Laboratory, Bound Brook, N. J. 1954 ASME Annual Meeting paper No. **54—A-259** (multilithographed; available to Oct. 1, 1955).

The continuing trend toward higher output boilers, the use of higher ash

coals, and the requirements for higher efficiency collectors have placed increasingly heavier demands on fly-ash collection equipment. Collection efficiency requirements have risen from the order of 90 per cent for earlier installations to 95 to 98 per cent for installations made during the past few years. Fundamental and practical improvements in collector design have kept pace with the heavier demands to a considerable degree, but the unpredictability of fly-ash characteristics is in many cases a complicating factor.

This paper surveys and analyzes the effect of the properties of fly ash on collector design and performance. That there exists a close relationship between fly-ash properties and collector technology is well known. For example, particle size imposes a basic limitation on inertial collectors, while electrical resistivity is a fundamental factor in the performance of electrical precipitators. A broad range of accumulated experience and knowledge now exists on these and other related factors and forms the basis of the paper.

The paper describes the important properties of fly ash; indicates the dependence of these properties on such factors as coal burned and furnace design and operation; shows the intimate relationship between fly-ash characteristics and collector performance; and brings out the principles and methods used in precipitator design and operation to overcome adverse characteristics of fly ash.

The most promising directions for future advances include: (1) Development of new collector methods and equipment which will be more independent of ash characteristics; (2) development of better methods for coping with high-resistivity ashes; (3) development of precipitators to operate at higher gas velocities; and (4) methods and principles for predicting and controlling fly-ash characteristics through better fundamental understanding of the factors governing fly-ash formation in furnaces.

Some Factors Affecting Fly-Ash Collector Performance on Large Pulverized Fuel-Fired Boilers, by C. R. Flodin and H. H. Haaland, Western Precipitation Corporation, Los Angeles, Calif. 1954 ASME Annual Meeting paper No. **54—A-212** (multilithographed; available to Oct. 1, 1955).

For many years fly-ash collection from pulverized units was not considered a particularly difficult problem since expected collection efficiencies were low, 80 to 90 per cent, and the character of the ash such that high-efficiency cyclonic collectors or electrostatic precipitators could satisfactorily meet the requirements. As an example, precipitators for this service ran one half to one quarter the size regularly used for cement and metallurgical operations for equivalent gas volumes and efficiencies.

But, today, demands call for higher efficiencies and low stack emissions so that it is necessary to regard the collection equipment as a part of the furnace and to obtain peak performance at all times. Yet, in the face of this demand, design factors for certain stations are working against the collector.

The authors discussed the major factors in dust-collector design both cyclonic and precipitator and in operations that bear upon an over-all evaluation of collector problems.

Steam-Piping Design to Minimize Creep Concentrations, by E. L. Robinson, Fellow ASME, General Electric Company, Schenectady, N. Y. 1954 ASME Annual Meeting paper No. **54—A-186** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1955).

Believing that steam-piping design for high-temperature service has heretofore been based largely upon elastic analysis of expansion stresses without adequate consideration of the importance of high-temperature creep, the author discusses the principles governing the relaxation of expansion stresses during service at high temperature, and points out the possibility of creep concentrations in local spots of maximum stress.

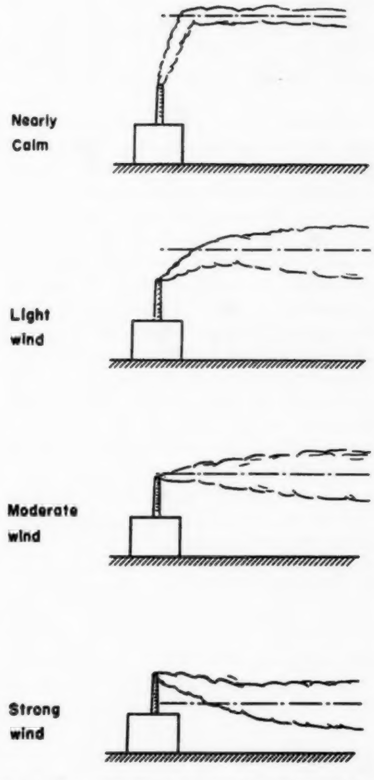
A number of specific examples are given to show that ordinary piping design can usually be made without such concentrations. Contrarywise, the type of expansion flexibility which invites excessive creep is illustrated.

The desirability of cold springing pipe so as to minimize stress at high temperature is emphasized.

Stack Heights Required to Minimize Ground Concentrations, by E. W. Hewson, University of Michigan, Ann Arbor, Mich. 1954 ASME Annual Meeting paper No. **54—A-211** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1955).

Aerodynamic and meteorological concepts are combined in a procedure for estimating ground concentrations of effluents from stacks with various possible heights and exit-gas velocities.

The operation of each of the several influences at work is described and a detailed example is given of how the most im-



Variation of effective stack height with wind speed is shown. With nearly calm conditions the gases rise almost vertically. High stack-gas temperatures and high velocities of emission may cause the gases to rise to considerable heights. Ascent to an effective stack height twice the actual stack height is not uncommon. As the wind speed increases, the height at which the plume levels off becomes progressively lower. For a moderate wind, the effective stack height is very little greater than the actual stack height. With stronger winds, aerodynamic down-wash of the gases may occur. If the stack is on a large building or near a complex of structures, the down-wash may be very pronounced.

portant phases were integrated into a consistent procedure for predicting ground concentrations in answer to a specific design problem.

Further improvements and refinements of the method are desirable and are being incorporated in a later study.

The author employs the reasoning that the atmosphere is a vast reservoir which may be used for the disposal of industrial wastes. If sensibly used for this purpose no nuisance or damage is incurred. But without due consideration of its widely varying diffusion capacity, annoyance, illness, or even death could conceivably result from discharging wastes into the air.

The Design and Comparative Costs for High Stacks, by E. J. Stankiewicz, Sargent & Lundy, Chicago, Ill. 1954 ASME Annual Meeting paper No. **54—A-260** (multilithographed; available to Oct. 1, 1955).

During the past 20 years aerodynamic and meteorological investigations have been conducted to improve the dispersion of flue gases from steam-generating power stations. This work has determined the required stack heights for a given locality in order to keep the flue-gas concentration at ground level within reasonable limits. In most cases this has resulted in higher stacks which have introduced structural problems concerning the vibration of tall structures under the action of wind forces. Due to the limited data available for use in analyzing the dynamic action of wind forces on stacks, it was not immediately apparent that the excessive swaying and ovaling of certain steel stacks were vibration problems that could not be solved by the use of conventional static wind loadings and the *MC/I* flexure formula.

This paper discusses the vibration of steel stacks and reviews current practice for designing steel, brick, and concrete stacks. Economic factors entering into the selection of a particular type of stack are discussed and charts are presented for use in obtaining comparative costs of steel, brick, and concrete stacks.

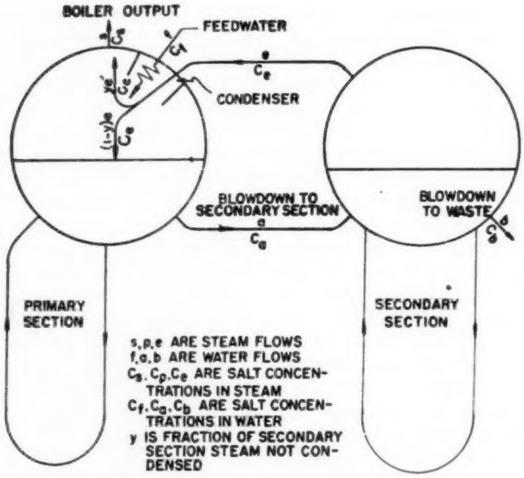
The Dual-Circulation Boiler in the Industrial Power Plant, by R. A. Lorenzini, Assoc. Mem. ASME, Foster Wheeler Corporation, New York, N. Y. 1954 ASME Annual Meeting paper No. **54—A-214** (multilithographed; available to Oct. 1, 1955).

Earlier discussions of the dual-circulation boiler design are reviewed. The purpose is to get around the problems facing industrial power plants with high-make-ups and high-solids concentrations in the feedwater.

This boiler design employs the principle of stage evaporation to maintain low concentrations without high blowdown rates. In dual-circulation units, provisions are made to condense all or a portion of the steam in a secondary section.

The design can be of either the single-drum or multidrum type and the arrangement depends on several factors such as anticipated feedwater conditions, design pressure, and permissible steam-release rates.

Major advantage of the dual-circulation principle is that the less expensive forms of chemical treatment consisting of hardness removal and silica reduction can be used.



A schematic representation of the dual-circulation boiler is shown here. The feedwater enters the primary section which usually comprises the waterwall or radiant heat-absorption section and the blowdown from this section serves as the feed for the secondary or convection heat-absorbing section. This scheme may be regarded as the equivalent of two boilers in one setting, each having independent circulating systems.

The author discusses water-treatment costs for four industrial areas using hot process and hot zeolite or employing demineralization. These costs comparisons included water-treatment equipment charges as well.

CO Boiler and Fluidized-Bed Steam Superheater on Sinclair Refining Company's New Fluid Unit at the Houston Refinery, by O. F. Campbell, Fellow ASME, and N. E. Pennels, Sinclair Refining Company, East Chicago, Ind. 1954 ASME Annual Meeting paper No. **54—A-20** (in type; to be published in Trans. ASME; available to Oct. 1, 1955).

The subject of this paper, a waste-heat boiler, is a new approach to a long standing refinery problem. With it, formerly wasted, low-heating-value flue gas from refinery catalyst regenerators can be used. The boiler is coupled to a fluidized-bed steam superheater to give the fluid catalytic cracking units an independent steam supply that is always under the control of the fluid unit's operator.

The heat input to the waste-heat boiler comes from the sensible heat and carbon-monoxide heat of combustion of the regenerator-exit gases, and from supplementary fuel required to burn the carbon monoxide to carbon dioxide. Just as this CO boiler is a "first" so is the method of controlling the fluidized-bed temperature by superheating steam a first. The difference between this superheater and one in a boiler is the medium surrounding the coils. In a boiler the hot flue gas flows past the tubes whereas these coils are immersed in a fluidized bed. The superheater tubes are bombarded with very fine hot catalyst particles and the heat-transfer rate is greater than in a conventional boiler. In fact, as compared with a steam superheater of a fired boiler, the heat-transfer rate appears to be from 5 to 7 times as much for the same temperature differential.

Operation of a respray to control the superheater temperature is described and many of the operating and design details are furnished. The heat absorbed by this respray superheater varies between 80,000,000 Btu per hr to 170,000,000 Btu per hr.

A number of advantages are cited by the authors for this new waste-heat boiler in refinery service.

A Technique for the Rapid Solution of an Air-Pollution Equation, by F. T. Bodurtha, Jr., E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. 1954 ASME Annual Meeting paper No. **54—A-187** (multilithographed; available to Oct. 1, 1955).

Current emphasis on the abatement of air pollution makes it necessary in many instances to provide means to keep the ground-level concentration of effluent gases below specified values. Stacks are commonly used for this purpose. Necessary stack heights for single sources may be calculated from formulas de-

veloped by Bosanquet and Pearson and Sutton.

Methods for rapid solution of the Bosanquet and Pearson formula are developed for use with stack gases at or near atmospheric density. The author cautions, however, that the present knowledge of atmospheric turbulence is greatly limited. Hence these equations apply with appropriately limited accuracy. Even with these restrictions the equations should help solve certain air-pollution problems, the paper concludes.

Lower Flue-Gas Exit Temperatures Through Removal of the Solids Ahead of the Air Preheater, by A. J. Tigges, Mem. ASME, Jackson & Moreland, Boston, Mass., and Hilmer Karlsson, Fellow ASME, The Air Preheater Corporation, New York, N. Y. 1954 ASME Annual Meeting paper No. **54—A-247** (multilithographed; available to Oct. 1, 1955).

This paper traces the reasoning behind a detailed research program for increasing over-all boiler efficiency by reducing gas-exit temperatures and yet maintaining the necessary high availability required by modern central-station practice. To achieve this goal required some solution for the corrosion and deposit problem which appeared in the path of the exit furnace gases.

There were three contributing factors all of which had to be present at the same time to cause deposits and later corrosion. They were, first, sulphur compounds in the fuel which at the present state of the art could not be removed economically. Next was the factor of water vapor always present in all boiler flue gases and not removable before it can cause trouble. Third and last, the finely divided particles of fly ash which must be present for deposit and corrosion to occur. This last factor semed to lend itself to further control than was the case in present-day boiler practice. The flue-gas borne solids had to be removed before they could become wet and adhesive, or in other words, in a dry state.

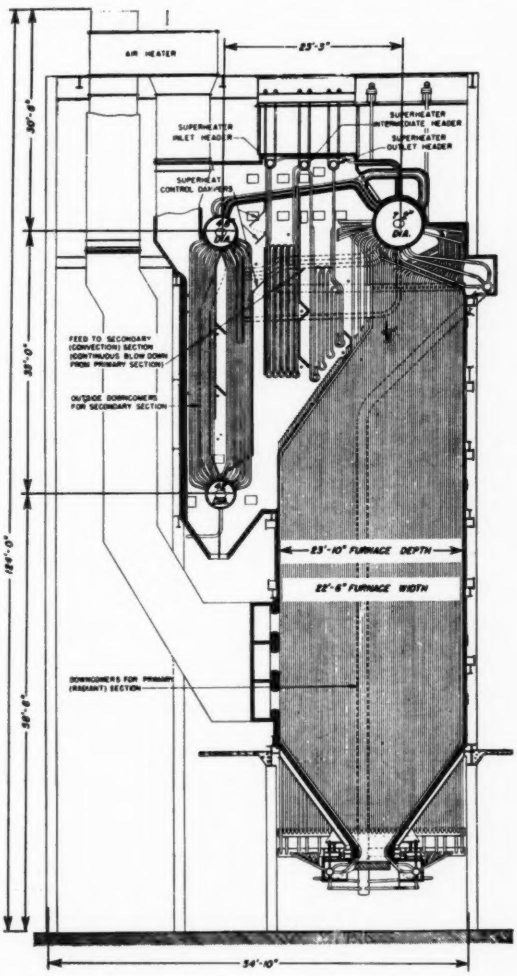
Particles in the size range of ten microns and down are responsible for causing visible stack discharges as well as deposit and corrosion problems on the low-temperature surfaces. This fly ash is hygroscopic, can adsorb water vapors and gases at relatively high temperature, and is particularly pronounced in the case of fines which can raise dew-point temperatures as much as 75 F. High-sulphur fuel oil indicates this phenomenon at temperatures over 350 F.

These theories were put to the test at three sites, a prototype dust collector installed on a small test set at Waltham, Mass., and experimental installation at the Hell Gate Station of Consolidated Edison Company, and a full-scale application at the Barking Steam Generating Station, east of London, England.

Operating Experience With Dual-Circulation Boilers Using 100 Per Cent Make-Up, by J. R. Goff and J. E. Harden, Standard Oil Company, Whiting, Ind. 1954 ASME Annual Meeting paper No. **54—A-232** (multilithographed; available to Oct. 1, 1955).

The authors trace the background of their company's decision to go to a 1500-psi dual-circulation boiler. One of the main reasons for the selection of this particular design was its expected ability to minimize the total solids and silica carryover as well as the required blowdown.

Results on this type boiler have been fine to date. Even though it is economical, because of a blowdown-heat-recovery system installed, to operate with a 7.5 per cent blowdown and carry a boiler-water concentration of 2000 ppm in the secondary steam-generating section, it would be possible, the authors stated, to carry a 3000 ppm concentration in this section and blowdown at a 5 per cent rate if there were not a heat-recovery system. The 400 to 10-psi auxiliary turbines in



Cross section of Foster Wheeler dual-circulation boiler. This boiler in some ways resembles a conventional three-drum boiler, but is actually divided into two separate heat-absorbing sections, each with its own independent circulating system. The primary, or high-duty section, comprises the high-density radiant heat-absorbing furnace, and the secondary, or low-duty section, is the low heat-absorption convection section of the boiler.

the power station use the exhaust steam from the 1500 psi topping turbines. If the silica in the steam, leaving the 1500 psi boilers, is in any appreciable quantity, it would show in these turbines first. They show no such indication.

Runs of 12 months were normal on the dual-circulation boilers between maintenance shutdowns. Control has been relatively easy, and rather extensive swings in high-pressure steam production have been handled smoothly. Gross efficiency has been maintained at from 86 to 87 per cent while burning oil or gas.

Accuracy and Results of Steam-Consumption Tests on Medium Steam Turbine-Generator Sets, by D. E. Kimball, Mem. ASME, General Electric Company, West Lynn, Mass. 1954 ASME Annual Meeting paper No. **54—A-253** (multilithographed; available to Oct. 1, 1955).

A REPORT is presented on tests of 22 units rated 2500 to 18,750 kw. These tests were conducted between 1946 and 1952 on facilities for loads up to 15,000 kw with steam conditions as high as 1500 psig, 1000 F. In analyzing the accuracy of the tests the author shows the existence of (1) 0.5 per cent uncertainty in manufacturing and factory-testing, (2) 0.3 per cent as the day-to-day uncertainty of tests, (3) 0.17 per cent uncertainty to be charged to the instrumentation of factory tests, and (4) probably 0.5 per cent poorer performance of tests in the owner's plants than in factory tests.

Certain precautions were taken in conducting the tests, including testing five sets of duplicate turbines, measuring most data on two or more identical instruments duplicating each other, retesting runs on the same turbine, and making certain that similar design and manufacturing as well as inspection practices applied both to the tested and untested turbines.

Design Aspects of an Electrostatic Precipitator for the Collection of Small Solids Ahead of the Air Heater, by H. Klemperer, The Air Preheater Corp., Wellsville, N. Y., and J. E. Sayers, James Howden & Company, Ltd., Glasgow, Scotland. 1954 ASME Annual Meeting paper No. **54—A-248** (multilithographed; available to Oct. 1, 1955).

THE development of a novel electrostatic precipitator is described that operates in the temperature range between 500 and 750 F, at a gas velocity of 40 fps.

The installation was put in at the Barking Station of the British Electric Authority on a bin and feeder-fired pulverized-coal unit with a rating of 150,000 lb per hr of steam. An economizer by-pass was provided so the normal gas-exit temperature from the economizer (400 F) could be regulated as desired to give a flue-gas temperature range from 400 to 700 F.

One major problem was to be certain the electrostatic precipitator employed was kept so clean that re-entrainment of already collected particles in the collection zone and back emission in the ionization zone would be impossible. To accomplish this a section of the electrostatic precipitator's collecting elements is cleaned periodically and at short intervals with a high-velocity scavenging gas flow and then at longer time intervals by a soot blower. The blown-off dust, carried by the scavenging stream, goes to a mechanical after-collector for removal.

The actual electrostatic collector operating at high temperature and with a gas velocity of 40 fps consists of 12 independent sectors, arranged in rotary symmetry. By means of rotating gas ducts, each sector passes through precipitating and cleaning periods in cyclic sequence. A mechanical collector precedes the electrostatic unit to lower the rate of growth of dust deposits on the electrodes.

The authors discussed the theory behind the precipitator design and described its application. The units have been in operation in their entirety since July, 1954.

Considerations in the Mechanical Design of High-Temperature Steam Turbines, by W. E. Trumpler, Jr., Mem. ASME, and E. A. Fox, Westinghouse Electric Corporation, South Philadelphia Works, Pa. 1954 ASME Annual Meeting paper No. **54—A-234** (multilithographed; available to Oct. 1, 1955).

FAR more is required in turbine design practice than mere substitution of numbers into formulas, according to this paper. Pure mathematical extrapolation of creep-test data must be tempered by judgment based on experience with materials involved and an understanding of service requirements.

When considering designs involving creep-type plastic flow, components must be considered to have a finite life. Such factors as initial cost, down time for replacement or maintenance, and thermal efficiency must be taken into account in determining the life for which each component must be designed for central-station service.

Increased activity must be encouraged in high-temperature testing programs to obtain more long-time creep rate and creep-to-rupture information, particularly on the newer austenitic superalloys. This work must include further study of behavior under the effect of biaxial and triaxial stress situations. More reliable means of judging materials from short-time creep data must be devised.

Superheater Metal Temperature, by G. Parmakian, Mem. ASME, and N. S. Sellers, Riley Stoker Corporation, Worcester, Mass. 1954 ASME Annual Meeting paper No. **54—A-181** (multilithographed; available to Oct. 1, 1955).

A DETAILED design procedure is outlined for evaluating the several variables involved in the determination of wall temperature of superheater and reheater tubing.

It is pointed out that the designer attempts to keep metal temperature as close as possible to steam temperature. Among the methods employed are (1) use of high steam mass flows, (2) selection of small tube diameters, (3) use of relatively low gas mass flows in high-temperature superheater sections, (4) liberal design of the manifold system, and (5) achievement of good gas temperature and flow distribution through furnace and burner design.

The authors also discuss actual temperature distribution, including metal-temperature unbalance and effect of burners, and make recommendations for using thermocouples to measure and record metal temperatures of superheaters as an aid to operation.

Principles of Boiler Design for High Steam Temperatures, by G. W. Kessler, Mem. ASME, The Babcock & Wilcox Company, New York, N. Y., 1954 ASME Annual Meeting paper No. **54—A-233** (multilithographed; available to Oct. 1, 1955).

SOME of the ways to achieve higher thermal-cycle efficiencies and the effect of improvement in heat cycle on boiler design are presented in this paper. Much of the paper is concerned with methods of maintaining steam temperature, including variation in furnace heat absorption, the use of radiant superheaters and reheaters, and applications of gas recirculation.

It is concluded that the major obstacle in the advance to higher steam temperatures is the restriction necessarily placed on furnace exit-gas temperatures to assure cleanliness of the convection surfaces.

The advance to higher steam temperatures will depend primarily upon overall economics, and material development and possible better-material usage will be major factors in future advancement.

Experience in Testing Large Steam Turbine-Generators in Central Stations, by E. M. Kratz, General Electric Company, Schenectady, N. Y. 1954 ASME Annual Meeting paper No. **54—A-258** (multilithographed; available to Oct. 1, 1955).

Experience in testing large steam turbine-generators in central stations has shown that consistent results can be obtained only by providing carefully calibrated instruments used carefully and with adequate knowledge of possible sources of error.

Since 1930 General Electric has tested 111 turbine-generators of 15,000 kw or larger, 102 of which were single-shaft machines and the remainder cross-compound units. Reheat was incorporated in the design of 12 machines, and 18 of the tests were on noncondensing turbines.

With respect to accuracy, throttle-flow measurements are the most frequent source of inaccurate data because of the difficulty in obtaining a precise basic measurement and the additional possible sources of error from miscellaneous flows and inadequate isolation. Generator load measurements may also be the source of significant errors, though of a smaller magnitude.

Drum Internals and High-Pressure Boiler Design, by E. M. Powell, Mem. ASME, and H. A. Grabowski, Mem. ASME, Combustion Engineering, Inc., New York, N. Y. 1954 ASME Annual Meeting paper No. **54—A-242** (multilithographed; available to Oct. 1, 1955).

Some of the factors which affect separation of water from steam in high-pressure boilers are discussed. These include the relative densities of water and steam, available pressure drop for drum internal design, relative quantity of water to steam in the mixture delivered to the drum, total throughput requiring separation, boiler-water level, and concentration of boiler-water solids. The paper gives a comparison of available head in a 110-ft-high furnace having a circulation ratio of 4 lb of water per lb of steam generated. At 1600 psig this head amounts to 10 to 12 psig, whereas under the same conditions at 2400 psig it falls off to 5 psig.

Another section of the paper takes up steam-purity testing and provides results obtained in four controlled-circulation boilers having drum pressures ranging from 2650 to 1775 psig and boiler-water concentrations between 100 and 400 ppm. For the conditions tested with turbo-separators installed in the drums, solids in the steam varied from 0.04 to 0.08 ppm.

Several charts are presented to show drum-metal temperature distribution and the effect of controlled circulation in insuring uniform heating rate for rapid starting of boilers.

Radiant Superheater-Design and Experience, by H. H. Hemenway, Mem. ASME, Foster Wheeler Corporation, New York, N. Y. 1954 ASME Annual Meeting paper No. **54—A-255** (multilithographed; available to Oct. 1, 1955).

Developments extending over a period of 35 years are outlined in this paper.

Since the first radiant superheater was installed in 1917, more than 1000 have been placed in service in boilers of many types ranging from box-header and two-drum low-head units for marine service to large central-station installations, of which the Port Washington and Oak Creek Stations of Wisconsin Electric Power Company are examples.

Some of the changes in material specification and manufacturing techniques that have occurred as the result of experience with radiant superheaters and reheaters are explained. Performance characteristics have been remarkably good, especially in the case of combination radiation-convection surfaces because of their compensating steam-temperature characteristics.

In concluding, the author stressed that modern thinking in the electric-power industry indicates a trend toward greater conservatism in design and that radiant steam-cooled surfaces have an important part to play in this trend.

Process Industries

Air Conditioning for Multistory Buildings, by P. B. Gordon, Mem. ASME, Wolf and Muñier, Inc., New York, N. Y. 1954 ASME Annual Meeting paper No. **54—A-265** (multilithographed; available to Oct. 1, 1955).

The art of installing air-conditioning systems for multistory buildings has undergone considerable change during the past eight years. The inherent problems of the tall building have provided the pressures and incentives that forced rapid change and development in methods and techniques. This paper reviews the particular problems that affect the application of air conditioning to multistory buildings (with particular regard to multiroom buildings) and discusses the methods developed or currently proposed to provide acceptable engineering-economic solutions.

The most serious application problem associated with multistory air conditioning concerns the most feasible method (as to engineering, economics, and practicality) of providing for the distribution of air-conditioning effect to the multistories, generally on a multiroom, multizone basis. This problem is complicated by the complexity of central systems versus units; high velocity versus low-velocity ductwork; air ducts versus water piping; as well as complexity of apparatus, controls, and the like.

There are many other problems—the best method of supplying refrigeration, the location of the cooling tower, use of steam or electric power for refrigeration plant; but the problem involving the major study and influencing the largest amount of over-all building investment will revolve around the manner of distributing the air-conditioning effect.

Mechanical Pressure Elements

Theories on Bourdon Tubes, by F. B. Jennings, Mem. ASME, General Electric Company, West Lynn, Mass. 1954 ASME Annual Meeting paper No. **54—A-168** (multilithographed; available to Oct. 1, 1955).

Theories of Walter Wuest, Alfred Wolf, Clark, Gilroy and Reissner, and the author, are compared.

Results are presented in curves plotting the same dimensionless ratios in all cases. These curves are useful in designing Bourdon tubes of flat-oval, elliptical, or pointed-arc cross section.

Experimental data are compared with a curve based on the author's simplified theory, and an empirical curve of similar shape is drawn. Results of analyses of tip travel and tip force are given.

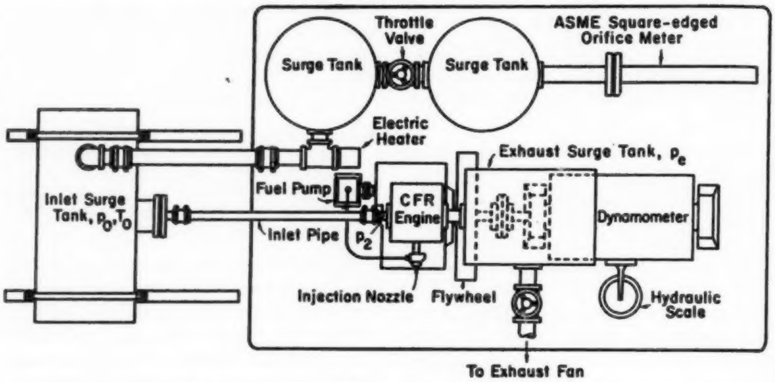
A start is made on the project of the ASME Research Committee on Mechanical Pressure Elements to change Bourdon tube designing from an art to a science.

The Influence of the Shape of the Cross Section on the Behavior of Bourdon Tubes, by Walter Wuest, Max-Planck-Institut, Germany. 1954 ASME Annual Meeting paper No. **54—A-165** (multilithographed; available to Oct. 1, 1955).

The important characteristic numbers (pressure sensitivity, stiffness, bending stresses, and overpressure safety) necessary for the characterization of a tubular spring (Bourdon manometer) may be related to four functions which depend, in addition to the cross-sectional shape, only on the axis ratio and on the parameter $\lambda = \alpha^2/sr$ (α, large semiaxis; s, wall thickness; r, radius of curvature). General calculations have so far been obtained only for the flat-oval shape and the results are shown. In the limiting case of small values of λ and arbitrary

values of α, a graphical or numerical solution is possible for arbitrary cross-sectional forms. A considerable simplification is obtained for small α and arbitrary λ, which is treated in this paper, in particular for cross-sectional forms which may be represented as polynomials of the sixth degree.

The calculation carried out for an approximate ellipse agrees well with the results of measurements, whereas the Reissner theory for an elliptical tubular spring deviates considerably therefrom. On the whole, the calculations show a considerable influence of the cross-sectional shape.



Schematic diagram of test setup used in the experimental investigation of dynamics in the inlet system of a four-stroke single-cylinder engine

Sensitivity and Life Data on Bourdon Tubes, by H. L. Mason, Mem. ASME, National Bureau of Standards, Washington, D. C. 1954 ASME Annual Meeting paper No. **54—A-169** (multilithographed; available to Oct. 1, 1955).

Information supplied by manufacturers to the Empirical Data Subcommittee of the ASME Research Committee on Mechanical Pressure Elements is presented in tabular and graphic form.

Sensitivities are compared with the theories of Wuest, Wolf, and Clark, Gilroy, and Reissner.

Plots of life data as a function of maximum fiber stress are shown for steel and for phosphor bronze.

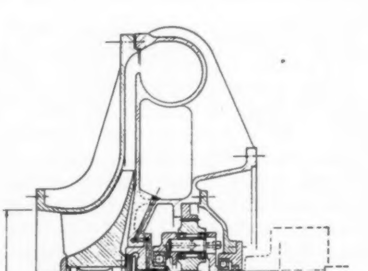
Oil and Gas Power

Dynamics in the Inlet System of a Four-Stroke Single-Cylinder Engine, by C. F. Taylor, J. C. Livengood, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass., and D. H. Tsai, National Bureau of Standards, Washington, D. C. 1954 ASME Annual Meeting paper No. **54—A-188** (multilithographed; available to Oct. 1, 1955).

This paper presents the results of a recent investigation of the inlet process in a four-stroke single-cylinder engine with an inlet pipe. The effects of inlet-pipe length, inlet-pipe diameter, inlet-valve timing, and some other design parameters were studied. Results showed that the dynamic effect of the inlet pipe on the engine volumetric efficiency was associated with (*a*) the process of accelerating the inlet-pipe air column during the first part of the inlet stroke, and taking advantage of the ramming effect of the air column during the last part of the same inlet stroke; and (*b*) the action of the standing wave set up in the air column during the preceding cycle. By a suitable choice of inlet pipe and valve timing, a considerable gain in volumetric efficiency over that for zero pipe could be obtained over a wide range of engine speed.

Centrifugally-Scavenged Two-Cycle Engines, by John Fullemann and T. O. Kuivinen, The Cooper-Bessemer Corporation, Mount Vernon, Ohio. 1954 ASME Annual Meeting paper No. **54—A-254** (multilithographed; available to Oct. 1, 1955).

Centrifugal scavenging is a natural for the two-cycle engine. Air flows match engine need throughout the speed range resulting in higher efficiency, lower fuel consumption, and greater load capacity. Mechanical design of the blower drive evolves from performance of a prototype unit described in this paper.



Cross section of experimental centrifugal-scavenging blower

The paper discusses centrifugal versus displacement blowers, preliminary tests and production version of blower, and mechanical-drive problems.

Nuclear Reactor Operation

Basic Safety Procedures in Reactor Operation, by R. L. Doan, Phillips Petroleum Company, Idaho Falls, Idaho. 1954 ASME Annual Meeting paper No. **54—A-71** (multilithographed; available to Oct. 1, 1955).

This paper is concerned primarily with the Materials Testing Reactor (MTR) of the AEC Reactor Testing Station at Idaho Falls, Idaho.

The operational safety of a nuclear reactor hinges on core geometry, excess reactivity, reliability of control system, and coolant, and adequacy of intrumentation. It is the practice to prepare a "Hazards Survey Report" for reactors constructed in this country. These reports are reviewed and discussed in detail with the operating contractor's personnel by a reactor safeguards committee which acts in an advisory capacity to the Atomic Energy Commission.

The basic philosophy of the reactor control for the MTR is to provide several independent devices for shutting the reactor down and none for starting it. Only the operator can bring the reactor to power, and his actions are at all times rendered ineffective if they do not conform to a predetermined safe procedure. Even if they do conform, any potential hazard that develops will override the operator's action.

Reactor-control instrumentation is based on signals arising in the neutron-detection instruments located at suitable positions inside the reactor structure. From these signals the logarithm of the neutron level and reactor period are

developed. The central problem of the control system at MTR is to provide continuous measurement of neutron-flux level over a range from 10^{-11} of full power, when there is already significant neutron multiplication, up to full power.

Heat Transfer

Compressibility Deviations for Polar Gases, by N. A. Hall, Mem. ASME, and W. E. Ibele, Assoc. Mem. ASME, University of Minnesota, Minneapolis, Minn. 1954 ASME Annual Meeting paper No. **54—A-140** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1955).

Departures of compressibility factors of polar gases from generalized compressibility charts have been noted by previous studies of gas compressibility as reaching such magnitudes as to reduce seriously the utility of such charts in describing the behavior of polar gases.

Employing an "Extended Law of Corresponding States," this paper shows that polar-gas compressibility departures correlate with the "reduced dipole moment," a parameter which is closely related to the molecular dipole moment of the particular polar gas.

Charts are presented which permit the calculation of compressibility factors for polar gases by applying a polarity correction to the compressibility as given by a standard chart.

Approximate Methods for Selection, Sizing, and Pricing of Steam Surface Condensers, by W. E. Ellingen, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. 1954 ASME Annual Meeting paper No. **54—A-127** (multilithographed; available to Oct. 1, 1955).

The steam surface condenser, by reducing steam to condensate and producing a vacuum at the turbine exhaust, extends the range of expansion in the steam cycle, thereby making more work possible per lb of throttle steam. This in turn lowers the turbine water rate and reduces the size of the steam-generating equipment. A second function of the surface condenser is to return distilled water to the system. It would seem that the most desirable practice would be to design a condenser for the highest possible vacuum. Economic considerations do not always make this possible.

This paper presents in chart form data for preliminary design and estimating of this important component in large steam-electric central stations.

The paper includes curves showing the relationship of circulating-water requirements and amount of steam condensed to required condenser surface for both one and two-pass surface condensers. Other curves provide information on weight and cost in relation to surface area and of the cost of tubing in relation to area, including variations for several tube materials. Costs of circulating and condensate pumps are plotted in terms of capacity.

The procedure outlined in the paper should enable the designer to arrive at an approximate price and weight, taking into consideration changes in circulating-water velocity, initial temperature difference, cleanliness factor, and circulating-water temperature.

Thermal Conductivity and Its Variability With Temperature and Pressure, by L. S. Kowalczyk, University of Detroit, Detroit, Mich. 1954 ASME Annual Meeting paper No. **54—A-90** (multilithographed; available to Oct. 1, 1955).

A summary of the present status of the theory of thermal conductivity is presented. Variability of thermal conductivity is explained by means of the nature of heat, structure of matter, and resistance, offered by matter to heat conduction at various physical states.

Thermal conductivity of matter depends upon its structure to a considerable degree. Structurally more organized materials show higher thermal conductivity, with successive increases from gases to liquids, amorphous and glassy materials, and crystals. Solid and molten metals show higher thermal conductivity than dielectric solids and nonmetallic liquids, respectively, because in metals lattice conductivity is strongly supported by a drift of free electrons. Generally speaking, thermal conductivity increases with pressure for all materials with the exception of a few metals.

Optimum Design of Shell-and-Tube Heat Exchangers, by M. T. Cichelli and M. S. Brinn, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. 1954 ASME Annual Meeting paper No. **54—A-125** (multilithographed; available to Oct. 1, 1955).

An extension and simplification of the procedure for obtaining the economic optimum design of shell-and-tube heat exchangers is presented.

The general case is solved where the process-fluid rate, the process-fluid temperature change, and the coolant-inlet temperature are given, and both the tube-side and shell-side pumping costs and heat-transfer resistances are appreciable.

Solutions are also given for the following cases: (*a*) The coolant-flow rate is fixed; (*b*) the shell-side velocity is fixed; (*c*) the tube-side velocity is fixed; and (*d*) the surface area is fixed.

The method of Lagrange multipliers for optimization calculations is demonstrated and used.

Feedwater Heaters—A User's Viewpoint, by S. M. Arnow, Mem. ASME, Philadelphia Electric Company, Philadelphia, Pa. 1954 ASME Annual Meeting paper No. **54—A-129** (multilithographed; available to Oct. 1, 1955).

The author defines an economical power plant as one which *works* continuously, unobtrusively, and trouble-free. From this viewpoint it is far less important that the heater have the exact number of tubes than that it have the exact number of vents at the proper places to prevent the tubes from corroding; less important to place the heaters at the exact theoretical point in the cycle than to be sure that the joints do not leak with any fluctuation in load; less important that certain terminal differences be maintained than that baffles and stay rods remain intact.

To carry out the mutual responsibility shared by manufacturers and users, the author urges heater designers to concern themselves with as much enthusiasm for mechanical design as they have heretofore expended upon thermal and heat-transfer considerations. This means job follow-up after installation, study of failures, and determination of causes, to prevent repetition.

Users, on the other hand, must write specifications that will allow designers to make free use of their experience and not restrict them unduly by specifying details within very narrow limits. He felt that it is enough to specify what heaters *should do.* Let the designers worry about *how* it should be done.

Several heater-cycle arrangements are shown and some typical troubles and remedies are discussed.

Economic Aspects of Shell-and-Tube Exchanger Design, by W. C. Beaton and P. A. Taxter, The M. W. Kellogg Company, New York, N. Y. 1954 ASME Annual Meeting paper No. **54—A-128** (multilithographed; available to Oct. 1, 1955).

A cost analysis of the manufacture of a shell-and-tube exchanger of the floating tube-sheet, removable-bundle-type construction is presented. Material and fabrication costs are compared for major elements using steel varying from medium to high tensile strength.

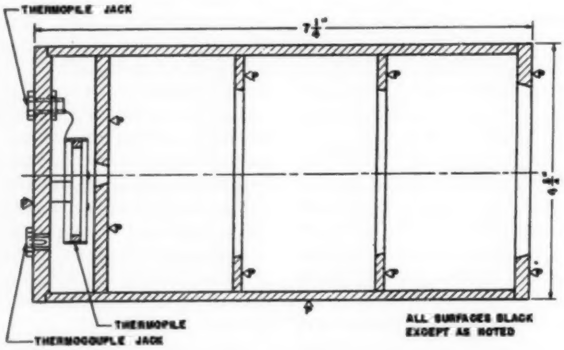
The authors present curves showing cost variations as a function of diameter with pressure and type of plate material

as parameters. Bar graphs are also shown to indicate variable labor and material costs for exchangers of varying pressure and shell diameter.

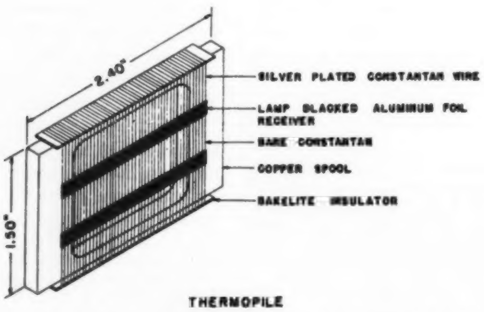
Total Normal Emissivity Measurements on Aircraft Materials Between 100 and 800 F, by N. W. Snyder, J. T. Gier, and R. V. Dunkle, University of California, Berkeley, Calif. 1954 ASME Annual Meeting paper No. **54—A-189** (multilithographed; available to Oct. 1, 1955).

Results of techniques developed and used to determine the mean effective emissivity of different surfaces over a range of temperatures from 100 to 800 F are presented. Measurement of radiant energy from the surfaces is accomplished by means of a 160-junction silver-constantan directional-thermopile radiometer.

Serious errors are noted and accounted for when improper use is made of polished shields in the experimental arrangements. This represents a refinement over previous techniques used. Further refinements are anticipated with the ultimate aim of checking against integrated spectral data. However, the data presented are useful aids as a phase of the technique of evaluation of equilibrium temperatures of different surfaces exposed to solar irradiation.



HALF SECTION RADIOMETER ASSEMBLY



THERMOPILE

Radiant energy was detected by means of a thermopile shown here. The thermopile consisted of approximately 104 turns per in. of No. 40 AWG constantan wire wound over glass insulators which were fastened to a copper spool. Silver was deposited on a portion of the coil in such a manner as to leave two lines of silver-constantan junctions. Aluminum-foil strips, lamp-blacked on the exposed side, were fastened to the two lines of junctions with dilute shellac. The cold-junction receiver strip was shielded from radiation that entered the front end of the radiometer by a plate that was at ambient temperature. This shield was lamp-blacked on the side facing the cold junctions and was polished on the side facing the opening of the radiometer. The hot-junction receiver strip was exposed to radiant energy from the sample through a narrow window.

The Economics of Heat-Exchanger Design, by W. C. Beekley, Mem. ASME, The Whitlock Manufacturing Company, Hartford, Conn. 1954 ASME Annual Meeting paper No. **54—A-179** (multilithographed; available to Oct. 1, 1955).

Current state of process heat-exchanger practice is reviewed.

Over the past twenty-five years, continuing heat-transfer research has resulted in greatly added knowledge and more accurate methods of calculation, while development in the physical characteristics of heat exchangers has made possible increasingly comprehensive specifications governing design and construction.

The author urged that there should be a clearer recognition of the economically optimum line between "basic mechanical design" and "design for manufacture." Within limits prescribed by thermal analysis and preliminary mechanical design, design for manufacture should be judged more searchingly by economic considerations.

Economies may be effected through quantity production by optimum selection of forms of materials, through the increased use of jigs by maintaining uniform criteria for tolerances and inspection, and by increased attention to what might be termed a standardized approach to the relation of practical construction and ideal conditions.

Hydraulic Analogy for Multipass-Crossflow Heat Exchangers, by S. I. Juhasz, Mem. ASME, *Applied Mechanics Reviews*, Midwest Research Institute, Kansas City, Mo., and F. C. Hooper, University of Toronto, Toronto, Can. 1954 ASME Annual Meeting paper No. **54—A-137** (multilithographed; available to Oct. 1, 1955).

The paper presents an extension of the hydraulic analogy to steady-state heat exchangers which was introduced by the authors initially as an analogy capable of yielding solutions for parallel flow only, and which was subsequently developed to cover the cases of simple crossflow.

This paper extends the analogy to the general case of multipass-crossflow heat exchangers. The terms parallel crossflow and counter crossflow are introduced to describe more exactly multipass-crossflow heat exchangers.

Sixteen cases first clearly defined by Bowman, Mueller, and Nagle of two-pass parallel crossflow, and the corresponding sixteen cases of two-pass counter crossflow are reviewed and defined. The new analogy technique permits solution in all of these cases in their multipass extensions, and includes all cases where variation of specific heat with temperature must be considered. The introduction of a generalized parallel-flow concept has made possible this further extension from single-pass to multipass crossflow.

The extended analogy to multipass-counter crossflow is in fact a combina-

tion of analogy and iteration in which n-1 curves have to be chosen initially in a more or less arbitrary manner, n being the number of passes. The iteration procedure is not mathematical but a repeated series of analog tests.

The new analog apparatus retains the virtues of relative simplicity and low cost. The time required for assembly and operation is moderate.

Measurement of Mean-Fluid Temperatures, by Lloyd Trefethen, Harvard University, Cambridge, Mass.. 1954 ASME Annual Meeting paper No. **54—A-135** (multilithographed; available to Oct. 1, 1955).

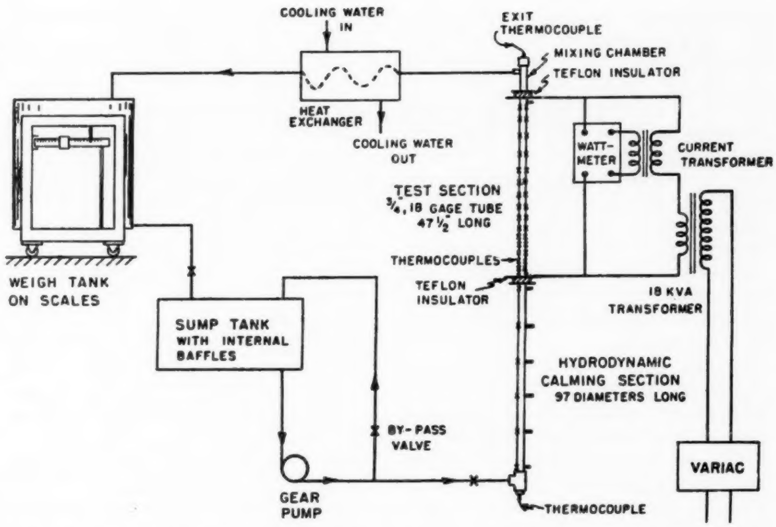
This paper is concerned with the meaning of the concept "mean temperature" for fluid passing a given section of a pipe. Other adjectives frequently used in place of "mean" are "mixed-mean," "mixed," "average," "bulk," "mixing-cup," and "mixing-box." In order to analyze this concept, the paper is largely devoted to four procedures which might be used to determine mean temperature at a cross section of a heat exchanger.

It is shown that the mean temperature obtained for a section of a heat exchanger will vary with the technique of measurement. Because of axial heat flow, neither a mixing box nor temperature and velocity probes in a turbulent fluid will give the energy mean temperature of the moving fluid. For long, thin-walled, uniformly heated tubes, the inherent discrepancy due to a mixing box is negligible if RePr > 30. The tube and apparatus, however, may have an axial conductivity many times that of the fluid, and it is shown that some of the experimental data for liquid metals may have been influenced by this mixing-box discrepancy.

Experimental Determination of the Thermal Entrance Length for the Flow of Water and of Oil in Circular Pipes, by J. P. Hartnett, Assoc. Mem. ASME, University of Minnesota, Minneapolis, Minn. 1954 ASME Annual Meeting paper No. **54—A-184** (multilithographed; available to Oct. 1, 1955).

Thermal entrance-length results are presented for the flow of two different fluids, water and oil, in a $^3/_4$-in., 4-ft-long tube with a constant heat input per unit length. A hydrodynamic calming section of 97-tube diam preceded the test section. Pressure-drop measurements in the water tests indicate that the condition of fully established flow at the test-section entrance was closely approximated, if not actually attained.

The following conclusions were set forth:



Flow circuit for the oil heat-transfer tests is shown. The medium-heavy crystal oil (Freezene oil) flowed by gravity from a baffled head tank to the suction side of a gear pump, which pumped the oil through the calming section and into the test section. From the test section the oil flowed through a cooler and finally into a weigh tank, which normally drained into the head tank. A gate valve on the weigh tank was closed whenever a flow-rate measurement was obtained. The flow rate was controlled by adjusting a valve on a by-pass line from the discharge of the pump to the head tank.

1 For flow in circular tubes with a constant heat input per unit length, the thermal entrance length for the case of established flow at the position where heating begins is 10 to 15 diam and is independent of Prandtl number, when the Prandtl number is greater than one.

2 The constant wall-temperature analysis reported by H. Latzko, in 1921, and the boundary-layer analysis reported by R. G. Deissler, in NACA TN 3016, October, 1953, yield satisfactory entry-length values for the constant heat-rate case. Since no Prandtl effect is apparent in the Reynolds range of 10^4 to 10^5, these predictions are also valid for Prandtl numbers in excess of unity.

3 In the transition region, as the Reynolds number is increased from 2000 to 10,000, the thermal entrance length steadily decreases from a large value representative of laminar flow, down to a value of approximately 10 diam.

Turbulent Heat Transfer and Friction in the Entrance Regions of Smooth Passages, by R. G. Deissler, Assoc. Mem. ASME, Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics, Cleveland, Ohio. 1954 ASME Annual Meeting paper No. **54—A-154** (multilithographed; available to Oct. 1, 1955).

The effect of various factors on the turbulent heat transfer and friction in the entrance regions of smooth passages is investigated analytically. The influence of Reynolds number, Prandtl number, initial velocity distribution, wall-boundary condition, passage shape, and of variable fluid properties, is predicted.

Integral heat-transfer and momentum equations are used for calculating the thicknesses of the thermal and flow boundary layers.

Results indicate that approximately fully developed heat transfer and friction are, in general, attained in an entrance length less than 10 diam. Substantial agreement between analysis and experiment was obtained for heat transfer to air in the entrance regions of tubes and parallel plates.

An Approximate Solution of Compressible Turbulent Boundary-Layer Development and Convective Heat Transfer in Convergent-Divergent Nozzles, by D. R. Bartz, Mem. ASME, California Institute of Technology, Pasadena, Calif. 1954 ASME Annual Meeting paper No. **54—A-153** (multilithographed; available to Oct. 1, 1955).

A method has been derived for computing the development of the velocity boundary layer, the temperature boundary layer, and the local convective heat transfer in convergent-divergent nozzles. The method is based on approximate solutions of the integral momentum and

integral energy equations for compressible turbulent boundary layers. To obtain the solutions, a flow model is adopted for which are prescribed the velocity and temperature profiles in the boundary layer, the skin-friction law, and the relation between heat and momentum transfer. The local heat-transfer coefficient is expressed as an explicit function of the boundary-layer thicknesses. Effects of nozzle size and throat radius-of-curvature on boundary-layer development and heat transfer are determined for certain similar nozzle contours in common use.

Results of the solution are demonstrated by a sample calculation for a conventional rocket nozzle operating under typical conditions. The computed local heat fluxes were found to be in approximate agreement with those measured during rocket-motor tests using a nozzle of the same contour.

Perturbation Solutions for the Periodic-Flow Thermal Regenerator, by L. L. Jones, Jr., Assoc. Mem. ASME, Institute for Co-operative Research, The Johns Hopkins University, Baltimore, Md., and D. H. Fax, Assoc. Mem. ASME, Westinghouse Electric Corporation, Pittsburgh, Pa. 1954 ASME Annual Meeting paper No. **54—A-130** (multilithographed; available to Oct. 1, 1955).

Advantages of the periodic-flow rotary regenerator as applied to the gas-turbine plant have been described by previous authors. The mathematical problem of finding the fluid and wall temperatures has been attacked previously by numerical and electrical analog methods.

The problem is to find periodic solutions to two pairs of first-order linear differential equations in two variables and three unknowns, where each pair of equations applies to a different interval of time. Schultz has presented a perturbation method of solution, which is limited to the case of complete symmetry in the fluids and matrix. His method is here generalized to permit the solution of the asymmetrical problem. Two particular types of asymmetry are treated in detail.

Optimum Heat Transfer for Minimum Thermal Stress in Nuclear-Reactor Shells, by F. P. Durham, University of Colorado, Boulder, Colo. 1954 ASME Annual Meeting paper No. 54—**A-126** (multilithographed; available to Oct. 1, 1955).

The author points out that gamma-ray heating must be considered in the design of many nuclear reactors. It is especially important in cases where such heating may cause thermal stresses in the external shell of the reactor if this shell is a structural member and subject to internal pressures which also result in stresses of large magnitude.

To arrive at values of thermal stresses resulting from gamma-ray heating requires the determination of the magnitude and distribution of absorbed gamma-ray energy, the determination of heat-transfer rates and temperature distributions, and the determination of thermal stresses resulting from the temperature distribution.

In the paper, criteria for minimizing thermal stresses are developed, along with the corresponding external cooling rates necessary to minimize thermal stresses.

Design charts are presented for rapid determination of approximate thermal stresses and heat-transfer rates, together with a numerical example illustrating use of the charts.

Heat Transfer and Pressure Drop for Viscous-Turbulent Flow of Flow-Air Mixtures in a Horizontal Pipe, by H. A. Johnson, University of California, Berkeley, Calif. 1954 ASME Annual Meeting paper No. **54—A-150** (multilithographed; available to Oct. 1, 1955).

The heat transfer and static pressure drop for two-phase, two-component flow of oil and air were measured for flow in a steam-heated horizontal 15 ft length of $^3/_4$-in. extra-heavy copper pipe. This is a second part of a two-phase heat-transfer program. The first part discussed water-air mixtures.

Tentative correlations are presented and used in a comparison of the oil-air and water-air results for heat transfer and nonisothermal pressure drop in the same test system.

Heat Conduction Methods in Forced Convection Flow, by S. Levy, General Electric Company, Schenectady, N. Y. 1954 ASME Annual Meeting paper No. **54—A-142** (multilithographed; available to Oct. 1, 1955).

Transient heat-conduction solutions are used to determine the thermal characteristics of fluid flowing in circular conduits, annuli, and between parallel plates. Jaeger's method of deriving the time lag for heat conduction in composite slabs (herewith extended to include composite cylinders) reduces the problem to a series of arithmetical calculations.

Numerical results are presented for flow between parallel plates with the following boundary conditions: Constant heat rate, linear wall-temperature variation, and constant wall temperature at one of the external surfaces with constant heat rate, no heat transfer, or zero temperature at the other surface.

Some solutions are extended to account for external wall resistance, and thermal entry lengths are evaluated for fluids with high or low Prandtl numbers.

Droplet Evaporation in a High-Temperature Turbulent Gas Stream, by J. W. Rizika, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1954 ASME Annual Meeting paper No. **54—A-141** (multilithographed; available to Oct. 1, 1955).

A method is presented to enable an approximate prediction of the channel length required to cool satisfactorily high-temperature turbulent gases by spray cooling. For a spray-cooling system to operate satisfactorily throughout a range of fluid-pressure conditions, there is a specific pressure at which the channel length required for droplet evaporation is a maximum. At fluid pressures above and below this specific pressure, evaporation will be completed in a distance less than this maximum channel length.

On the Evaporation of a Drop of Volatile Liquid in High-Temperature Surroundings, by W. E. Ranz, The Pennsylvania State University, State College, Pa. 1954 ASME Annual Meeting paper No. **54—A-143** (multilithographed; available to Oct. 1, 1955).

Because the general phenomenon is one of heat and mass transfer for a spherical shape, the evaporation of a single drop is of considerable engineering interest and has a direct relationship with the processes of spray cooling, drying, absorption, desorption, humidification, and combustion. The purpose of this paper is to add to the extensive literature on the subject, a statement of the effect of simultaneous mass transfer on the rate of heat transfer, clarifying a point which in the past has led to many errors in interpreting data and in estimating the rate of evaporation under extreme conditions.

The evaporation of a drop of volatile liquid in high-temperature surroundings is analyzed in terms of the rate of heat transfer. Transfer of heat by mass transfer and by radiation as well as by conduction is taken into account for a pseudostationary and steady state without convection. The flow of cold vapor to the surroundings during evaporation requires that a considerable amount of heat conducted inward be used to warm vapor moving outward. This waylay-

ing of heat energy results in a significant decrease in the apparent rate of heat transfer as measured by the rate of evaporation.

Applications of the theoretical results to evaporation and combustion are discussed, and an empirical treatment for cases of free and forced convection is indicated.

The Influence of Curvature on Heat Transfer to Incompressible Fluids, by Frank Kreith, Assoc. Mem. ASME, Lehigh University, Bethlehem, Pa. 1954 ASME Annual Meeting paper No. **54—A-55** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1955).

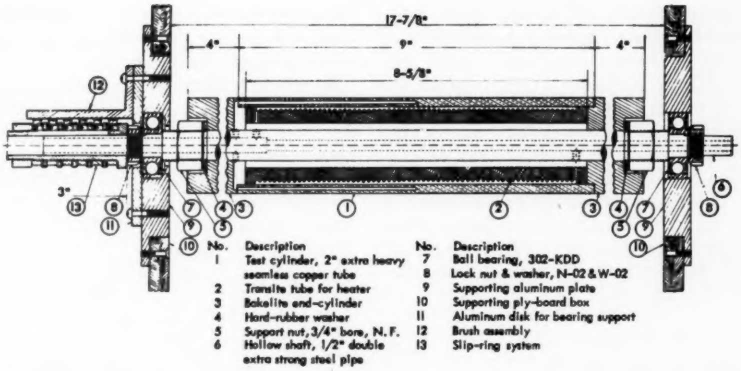
There are many instances in heat-transfer devices where an incompressible fluid is heated or cooled while flowing in a channel along a surface which is curved in the direction of flow. This paper reports on a study of the effect of curvature by comparing heat-transfer coefficients for fluids, flowing along a heating surface of concave curvature in the direction of flow with heat-transfer coefficients for a convex heating surface and for a flat heating surface.

Using experimental results of wall shear and velocity distribution obtained by Wattendorf, Nusselt numbers were calculated for Reynolds numbers ranging from 10^4 to 10^6 and Prandtl numbers ranging from 0.01 to 100 and for radii of curvature ranging from 0.12 to 1.2 ft.

It was found that the heat-transfer coefficient from a heating surface with a concave curvature is considerably higher than for a heating surface of the same curvature in a convex configuration under similar conditions of flow cross-sectional area and flow rate. The calculated results are in agreement with results from heat-transfer experiments using flow channels with convex and concave heating surfaces in the direction of flow.

Free-Convection Heat Transfer From a Rotating Horizontal Cylinder to Ambient Air With Interferometric Study of Flow, by G. A. Etemad, University of Buffalo, Buffalo, N. Y. 1954 ASME Annual Meeting paper No. **54—A-74** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1955).

Free-convection heat-transfer correlation for a rotating horizontal cylinder in air was evaluated experimentally for a range of Reynolds numbers from 0 to 65,400. The stability of flow around the rotating cylinder and the transition from laminar Couette flow to fully developed secondary flow were investigated with the aid of a Zehnder-Mach interferometer.



Details of the copper model construction are shown. The heater consisted of No. 22 nichrome wire wound around a threaded transite tube and inserted in the copper cylinder. The surface temperature of the cylinder was measured by means of thermocouples. The thermocouple wires and the electrical power leads were led through the hollow shaft to a brush-and-slip-ring arrangement.

Two types of cylindrical models were used, one of bakelite $2^1/_2$ in. OD with nichrome-ribbon surface heaters, the other of copper $2^3/_8$ in. OD internally heated. The temperature difference between the surface of the test cylinder and the ambient air was varied from 8 to 195 F and the rotational speed of the test cylinder was varied from 0 to 5250 rpm. Heat-transfer coefficients were calculated from observed electrical and temperature data, and the heat input to the test section was corrected for radiation and conduction losses.

A critical Reynolds number, at which the Couette flow becomes unstable, was determined. At Reynolds numbers below the critical value, the rate of heat transfer slightly decreases with the increase of Reynolds number but is controlled chiefly by free convection. The decrease of Nusselt number in this range of Reynolds number is due to the laminar Couette flow, which winds the hot air of the free-convection chimney around the cylinder and increases the effective free-convection thermal-boundary-layer thickness. At Reynolds numbers above the critical value a cellular type of secondary flow develops and the rate of heat transfer increases with rotational speed. In this range of speed, the effect of free convection on heat transfer decreases with increase in Reynolds number and, for the range of Grashof numbers covered in this experiment, it becomes almost negligible at Re 8000. The secondary flow around the rotating cylinder becomes turbulent at a Reynolds number of about 14,500. The transition from laminar to secondary flow and the transition from secondary to turbulent flow occur first along the top of the rotating cylinder and then spread downward as the Reynolds number increases.

The heat-transfer data obtained agree well with the experimental results of Anderson and Saunders. The experimental results for the models in the stationary state exhibited substantial correlation with published data.

Remarks on the Mechanism and Stability of Surface-Boiling Heat Transfer, by Frank Kreith, Assoc. Mem. ASME, and A. S. Foust, Lehigh University, Bethlehem, Pa. 1954 ASME Annual Meeting paper No. **54—A-146** (multilithographed; available to Oct. 1, 1955).

In some recent papers the present state of knowledge of nucleate-boiling processes has been summarized; tentative suggestions for correlating and predicting heat-transfer rates have been proposed and the stability limits of boiling heat transfer have been discussed. All of these recent developments indicate that the key to a better understanding of the heat-transfer process with nucleate boiling is the mechanism of formation and the motion of the vapor bubbles.

It is generally agreed that the large heat-transfer coefficients which have been obtained with surface boiling are a result of the oscillation of bubbling which stirs up the laminar boundary layer and so removes the high thermal resistance of this otherwise stagnant liquid film. In order to evaluate quantitatively the effect of this microconvection caused by the bubble motion, it is necessary to postulate a model suitable for a mathematical description. This approach has been partially successful, but there are some unresolved questions regarding the selection and range of applicability of the model.

The other problem is that of stability of boiling heat transfer. When the heat flux is increased beyond a certain point

or when either the flow rate or the pressure is decreased below a certain critical value, the boiling ceases to be stable and so-called "burnout" of the equipment may result. For practical application of boiling heat transfer in industrial equipment, it is of prime importance to prevent instabilities from occurring.

This paper presents some recent theories of nucleate boiling with regard to their range of applicability. New criteria for the stability limits of boiling heat transfer are suggested.

Radiation Analysis by the Network Method, by A. K. Oppenheim, Mem. ASME, University of California, Berkeley, Calif. 1954 ASME Annual Meeting paper No. **54—A-75** (multilithographed; available to Oct. 1, 1955).

PROBLEMS of net radiation transfer in enclosures involve proper accounting of all the interreflections of radiation beams. This is shown to be equivalent to the solution of electrical networks made up of conductances which are fully determined by surface shape factors, reflectivities, and transmissivities of the system elements. The scope of the analysis is restricted to diffuse radiation within enclosures consisting of gray surfaces and containing gray gases.

The method is applicable to heat transfer as well as to illumination problems. The network principle can be extended to other mechanisms of heat transfer and energy transformation. This is illustrated by an example of a combustion furnace where the radiation network is combined with convection and combustion networks.

Effect of Vapor Velocity on Laminar and Turbulent Film Condensation, by W. M. Rohsenow, Mem. ASME, J. H. Webber, and A. T. Ling, Assoc. Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1954 ASME Annual Meeting paper No. **54—A-145** (multilithographed; available to Oct. 1, 1955).

THE liquid condensate layer (film) on vertical plates or tubes under the influence of the gravity force flows downward in essentially laminar flow over the upper part of the surface, but may change to turbulent flow over the lower part if the condensation rate is sufficiently high. Colburn reviewed the results of Kirkbride and developed a correlation equation based on a very elementary description of the condensate layer which was considered to be composed of a laminar sublayer and a turbulent outer region. The laminar layer was considered to have the sole resistance to heat transfer. This type of analysis was extended by Carpenter and Colburn to include the effect of vapor shear stress.

Seban performed an analysis of the turbulent condensate film assuming the existence of the "universal velocity distribution" of Prandtl-Nikuradse. The calculated results extend over a wide range of Prandtl numbers and agree well with the empirical results of Colburn in the range $N_{Pr} = 2$ to 5.

This paper presents analyses showing the effect on rates of condensation of vapor shear stress at the liquid-vapor interface. Both laminar and turbulent films are considered and are combined to give analytical results for the case of laminar flow on the upper portion of a plate and turbulent flow on the lower portion. The analysis of the turbulent film is essentially an extension of the one presented by Seban.

The system considered is a vertical flat plate with pure saturated vapor condensing on the plate whose temperature is uniform. Flow acceleration and momentum changes are neglected in the analysis. The physical properties are assumed to be constant.

Numerical Solutions for Laminar-Flow Heat Transfer in Circular Tubes, by W. M. Kays, Mem. ASME, Stanford University, Stanford, Calif. 1954 ASME Annual Meeting paper No. **54—A-151** (multilithographed; available to Oct. 1, 1955).

INTEREST in laminar-flow heat transfer in tubes has arisen in the past primarily in connection with heat-exchanger applications involving oils. Current interest is in high-temperature compact heat-exchanger applications where tube diameters are less than $^{1}/_{4}$ in. and densities are low.

Existing solutions for laminar-flow heat transfer in a circular tube are generally based on the assumption of a fully established parabolic velocity profile at the point in the tube where heating begins. For high Prandtl number fluids, such as viscous liquids, this idealization does not restrict the usefulness of the solutions, but in the gas range, near a Prandtl number of 1.00, the assumption of a fully established velocity profile at the tube entrance can, for many applications, lead to a considerable error in predicted performance.

The velocity profiles of Langhaar have been employed in numerical solutions for boundary conditions of constant wall temperature, constant wall-to-fluid temperature difference, and constant heat input per unit of tube length. Local Nusselt numbers have been evaluated for all three cases, and mean Nusselt numbers with respect to tube length have been evaluated for the first two.

Experimental data for the cases of constant wall temperature and constant heat input are shown to be in good agreement with the numerical solutions, while differing substantially from solutions based on the parabolic velocity assumption.

An Interferometric Study of Free-Convective Heat Transfer from Enclosed Isothermal Surfaces, Part I—Horizontal Cylinders, Part II—Short Vertical Prisms, by C. D. Jones, Assoc. Mem. ASME, The Ohio State University, Columbus, Ohio, and D. J. Masson, Mem. ASME, General Electric Company, Schenectady, N. Y. 1954 ASME Annual Meeting paper No. **54—A-147** (multilithographed; available to Oct. 1, 1955).

WHEN any heat-dissipating surface is placed in close proximity to an enclosing structure, some effect upon the local and average free convection may be expected. These investigations provide such data and correlate them with those of unconfined surfaces for two typical geometric configurations. Because of the basic similarity of the subjects and the methods of the investigation, the studies of enclosed cylinders and prisms are presented together. However, since the methods of data analysis and correlation differ, the paper is divided into two independent parts.

Experimental data and their correlation by dimensionless parameters are presented for an investigation of the point and average heat-transfer coefficients on a horizontal, isothermal cylinder as affected by the location of plane enclosures such as walls, ceilings, floors, and corners under free-convection conditions.

Results of an experimental investigation of the heat transfer from confined vertical surfaces of small height are correlated on the basis of Grashof number, Nusselt number, and the distance between the heated and cooled surfaces. Expressions are given for point heat transfer and average heat transfer by free convection.

Data on the free-convective temperature fields in these investigations were obtained with a Zehnder-Mach interferometer. With this instrument, variation of the density of the air surrounding the heated object can be detected from the shape and spacing of alternately dark and light interference bands. In an air space of uniform pressure, the density variation is produced entirely by convection and conduction of heat. Therefore the light interference bands can be

interpreted in terms of temperature by the use of the proper transformation equations. The field of view of the interferometer, as determined by the size of the optical plates, is an ellipse with axes of 7.44 and 4.50 in.

Heat Transfer and Temperature Distribution in Laminar Film Condensation, by W. M. Rohsenow, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1954 ASME Annual Meeting paper No. **54—A-144** (multilithographed; available to Oct. 1, 1955).

Most of the analyses of laminar film condensation since Nusselt's pioneer paper have assumed a linear temperature distribution within the film. Bromley performed an analysis allowing for a nonlinear temperature distribution but omitting the effect of crossflow within the film. His result is in variance with the result obtained in this paper.

The analysis presented attempts to obtain the correct nonlinear temperature distribution and heat-transfer rates in a liquid condensate film, which under the influence of gravity flows downward in essentially laminar flow on vertical plates or tubes. In the analysis, it is assumed that the vapor is saturated with no noncondensable gas present; the wall-surface temperature is uniform; there is no appreciable vapor shear stress existing at the liquid-vapor interface; and the physical properties of the fluid a constant and uniform.

Applied Mechanics

Bending of Orthogonally Stiffened Plates, by W. H. Hoppmann, 2nd, Mem. ASME, The Johns Hopkins University, Baltimore, Md. 1954 ASME Annual Meeting paper No. **54—A-31** (in type; to be published in the *Journal of Applied Mechanics*).

In this paper the flexure theory for plates of orthotropic material is applied in the case of orthogonally stiffened plates using an experimental method to determine plate stiffnesses in bending and in twisting. Once these stiffnesses, or elastic moduli, have been determined by test they may be used in calculating bending deflections for plates of identical stiffened construction but any given boundary conditions.

As an example, calculated deflections of a stiffened circular plate with clamped edge are compared with those which were determined experimentally. It is also demonstrated that the theory can be applied to the case of vibration of a stiffened plate if, in addition to the orthotropic elastic constants, the weight per unit area of the plate is determined.

Various experimental results show considerable promise for use of the proposed combination of theory and experimental method in the analysis of both statically and dynamically loaded plates with attached stiffeners.

The Root Section of a Swept Wing—A Problem of Plane Elasticity, by B. C. Hoskin and J. R. M. Radok, Aeronautical Research Laboratories, Department of Supply, Melbourne, Australia. 1954 ASME Annual Meeting paper No. **54—A-97** (in type; to be published in the *Journal of Applied Mechanics*).

The methods of N. I. Muskhelishvili are used to obtain the stresses in an approximately square plate, subject to concentrated forces at two opposite corners, acting in the direction of the diagonal, and to certain shear-stress distributions along the sides. These shear-stress distributions have been chosen to conform approximately with those observed at the corresponding boundaries during tests on a 45-deg sweptback tube with ribs normal to the leading edge.

Numerical results, involving loading parameters, are presented in the form of tables and graphs. Use of the numerical results is illustrated by application to a wing under varying degrees of torsion and bending.

ASME Transactions for February, 1955

The February, 1955, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

Determination of the Thermal Conductivity of Molten Lithium, by H. A. Webber, David Goldstein, and R. C. Fellinger. (53—A-79)

On the Drilling of Metals—1 Basic Mechanics of the Process, by C. J. Oxford, Jr. (53—A-167)

The Shear Stress in Metal Cutting, by M. C. Shaw and Iain Finnie. (53—A-158)

Piping-Flexibility Analysis, by A. R. C. Markl. (53—A-51)

Elastic Constants and Coefficients of Thermal Expansion of Piping Materials Proposed for 1954 Code for Pressure Piping, by Rudolph Michel. (53—A-52)

In-Plane Bending Properties of Welding Elbows, by P. L. Vissat and A. J. Del Buono. (53—A-70)

Viscoelasticity of Polymethyl Methacrylate—An Experimental and Analytical Study, by J. K. Knowles and A. G. H. Dietz. (53—A-100)

A Novel Cooling Method for Gas Turbines, by Edward Burke and G. A. Kemeny. (53—A-180)

The Free-Piston-and-Turbine Compound Engine—A Cycle Analysis, by A. L. London. (53—A-212)

Kinetic Theory of Evaporation Rates of Liquids, by E. F. Lype. (53—A-134)

Pulsation Absorbers for Reciprocating Pumps, by E. G. Chilton and L. R. Handley. (53—A-81)

Pulsating-Flow Measurement—A Literature Survey, by A. K. Oppenheim and E. G. Chilton. (53—A-157)

How to Order ASME Papers

Copies of ASME technical papers digested this month are available in pamphlet form. Please order only by paper *number;* otherwise the order will be returned. Orders should be addressed to the ASME Order Department, 29 W. 39th St., New York 18, N. Y. Papers are priced at 25c each to members; 50c to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society. The coupons, in lots of ten, are $2 to members; $4 to nonmembers.

Note: No digests are made of ASME papers published in full or condensed form in other sections of Mechanical Engineering.

Copies of all ASME publications are on file in the Engineering Societies Library and are indexed by the Engineering Index, Inc., both at 29 West 39th Street, New York, N. Y.

ASME Transactions and the *Journal of Applied Mechanics* are on file in the main public libraries of large industrial cities and in the technical libraries of engineering colleges having ASME Student Branches.

ASME Order Department
29 W. 39th St., New York 18, N. Y.

Date............

Please send me the papers indicated by the following circled numbers:

54—A-20	54—A-143	54—A-211
54—A-31	54—A-144	54—A-212
54—A-55	54—A-145	54—A-214
54—A-71	54—A-146	54—A-218
54—A-74	54—A-147	54—A-219
54—A-75	54—A-150	54—A-220
54—A-90	54—A-151	54—A-232
54—A-97	54—A-153	54—A-233
54—A-125	54—A-154	54—A-234
54—A-126	54—A-165	54—A-242
54—A-127	54—A-168	54—A-247
54—A-128	54—A-169	54—A-248
54—A-129	54—A-179	54—A-253
54—A-130	54—A-181	54—A-254
54—A-135	54—A-184	54—A-255
54—A-137	54—A-186	54—A-258
54—A-140	54—A-187	54—A-259
54—A-141	54—A-188	54—A-260
54—A-142	54—A-189	54—A-265

Name..............................

Address............................

☐ Remittance enclosed ☐ Bill me
☐ ASME Mem. ☐ Nonmem.

Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Power-Transmission Gears

Comment by Spencer Bowman[1]

As in the author's case,[2] we are constantly striving to produce more effective machinery, and in many cases, size limitations have already been reached. Our next and only move with existing metallurgy is to increase over-all efficiency and by all means establish a better means of predetermining the capacity of all mechanical equipment.

Dependability

Dependability of a product in a great number of cases is increased by the use of precision-ground gears.

By the use of precision gears, it is possible to design even a bevel gear with total interchangeability without the use of shims or other adjustments.

Efficiency

The mechanical efficiency of a ground tooth profile is so far superior to a cut gear that if many meshes are involved less horsepower is required to do the same amount of work, because the horsepower transmitted is a function of the relationship between input horsepower and actual horsepower going into work. This has been particularly important in deep mining equipment where horsepower is always insufficient and where, if we had five times as much as we have at this time, we still would only be reaching a closer optimum. This advantage is realized every hour the machine is in operation.

Error in Action

Gears with great errors in action also have great surging at the pitch line velocitywise. This surging power induces cyclic stress pulsations on the gearing train and also materially affects the efficiency of the over-all mechanism, particularly in the higher speed ranges.

The efficiency referred to is the difference between the actual horsepower developed and the actual horsepower going into work. It appears that the most practical conclusion, efficiencywise, is determined by theoretical means, as a practical determination of energy going into work is very difficult to measure even with most modern instrumentation.

Manufacturing

Except for slight additional material cost, the cost of manufacturing a precision gear is not as exaggerated as one might first believe. Preparing the blank is quite comparable to commercial gearing and induces no particular cost above that of commercial standards.

In steel gears heat-treatment is, of course, the primary consideration and consummate care should be taken in order to get the most from a given gear. This expenditure in the case of carburized gears allows a percentage of stress increase which proportionately carries more than its share of the cost burden.

Grinding

The grinding process provides more uniform load distribution, as well as a smoothness of operation difficult to attain with even the finest cut gears available. It must be pointed out, however, that grinding operations must be performed properly in order to prevent grinding checks and cracks, particularly in the root fillet.

When incorporating the carburized-and-ground-gear technique, all the advantages of this system should be taken into consideration. A few of the many advantages, particularly in the spur gear and straight-tooth bevel gear, are listed as follows:

1 A stronger product, in a smaller space, with less weight.
2 Total interchangeability.
3 Greater dependability in a greater percentage of the products produced.
4 Fewer problems resulting from elevated temperatures.
5 Far greater mechanical efficiency.
6 Gearing that is far more quiet.
7 Less over-all shipping cost with less material-handling cost.
8 Greater life expectancy on bearings, keys, splines, etc.
9 Smaller surrounding housings, structures, etc.

Comment by Leo Kingston[3]

The author is to be congratulated on an excellent and very interesting paper. It is gratifying to see ideas expressed that are known and accepted in the aircraft industry, yet are not sufficiently appreciated in the general mechanical industry.

Of significance are the comparisons of sizes between equally accurate cut gears, of carburized ground gears, and carburized ground planetaries. The tremendous weightsaving that can be accomplished is not generally realized.

We in the aircraft industry have to meet the most exacting requirements as to accuracy and physical characteristics of gears. Therefore our suppliers of gears and gear drives in many cases had to improve their equipment, their methods, and their quality control before their gears became acceptable. However, many gear manufacturers attempt to produce gears to the designs and specifications of their customers with the limitations imposed by out-of-date equipment.

Aircraft gearing presents an ever-increasing volume of business for those manufacturers who are willing to learn and to accept the burden of quality requirements in excess of present industrial standards.

Already, designers of high-powered aircraft drives are limited by lack of availability of adequate gear-grinding equipment of large PD capacities. It is hoped that publications of this challenging nature will be a spur to awaken the broad genius of American industry.

Comment by H. J. Zimmermann[4]

The information given in this paper should serve to call attention to major design advantages obtained by methods

[1] In charge of Coal Mining Machinery, Research Development, Cleveland Rock Drill Division, Westinghouse Air Brake Company, Cleveland, Ohio.

[2] "Manufacturing Methods of Power-Transmission Gears and Their Influence on Design Considerations," by D. W. Botstiber, MECHANICAL ENGINEERING, vol. 76, September, 1954, pp. 735–738.

[3] Senior Staff Design Engineer, Piasecki Helicopter Company, Morton, Pa.

[4] Senior Development Engineer, The Franklin Institute Laboratories of Research and Development, Philadelphia, Pa.

which by themselves are known, but have not been applied in the past, at least not to any significant extent.

Carburized gears are standard in the automotive industry. In fact, modern cars and trucks would be completely impossible without carburized gears. These gears are small, and distortion in processing is not enough to make grinding necessary.

Aircraft Drives

In aircraft drives, ranging from 100 to 2000 hp, with output speeds from 3000 down to 150 rpm, together with most stringent requirements for reduction of size and weight, the physical characteristics of carburized gears are a necessity. Accuracy requirements are such that grinding is imperative. American aircraft industry has been highly progressive in adopting latest gear-manufacturing methods. The aircraft industry thus has created a special gear industry with manufacturing standards and engineering considerations all its own.

Industrial and Marine Gears

In contrast with this, the makers of industrial and marine gears in the United States seem to adhere tenaciously to the old traditional methods. Obtaining a carburized and ground gear of more than 10 in. PD is almost impossible. Yet, investigations of foreign gear developments show that new European merchant and naval vessels use carburized and ground gears predominantly. The result is a substantial gain in available space within the hull and increased freedom of arrangement in design. The reduction in volume and weight of a drive with ground gears is followed by a reduction in cost, which greatly exceeds the additional cost of grinding. Why then, in view of the outstanding advantages of ground gears, is gear grinding not more universally adopted? The writer believes it is not so much the cost of grinding as it is the cost of grinding equipment.

The author's paper should be encouraging to the gear industry, and he should be commended for his contribution toward the breaking of the conservatism which hampers progress of our industrial and marine gear industries.

Comment by Louis Manning[5]

This paper effectively portrays the means by which gear drives may be reduced to minimum size by selection of proper materials and manufacturing methods.

[5] Head, Field Service Section, Goodyear Aircraft Corporation, Akron, Ohio.

However, minimum-size gear trains are not always governed by gear strength alone and it would be well to mention some of the other possible restrictions which may rule in favor of the larger gears in a few special cases. The most important of these may be the added complexity of adequate lubrication and cooling systems.

Lubrication

An oil-pressure jet to each gear mesh is ordinarily required for highly loaded gears, whereas the more lightly loaded larger gear may be lubricated satisfactorily by churning through a wet sump. In providing this pressure-lubrication system, it is necessary to complicate the basically smaller gear train with at least one pair of accessory-drive gears, a lubricating pump, and extra plumbing.

If the smaller gearbox results in deficient heat dissipation, a radiator or heat exchanger must be provided. In most applications, this in turn demands the use of a fan or coolant pump with more gears to drive them. This does not mean that the smaller gear train is ruled out economically but only that a more careful study is required with possibly some compromise in absolute minimums.

Gear Size

Use of the smallest possible gears may also crowd the geometry to such an extent that it is not possible to install bearings with adequate load-carrying capacity. It is always a great temptation to use marginal bearings in order to utilize smaller gears but the experienced designer will provide the necessary space with larger gears. In some cases, even the previously marginal bearings then become of adequate capacity as a result of reduced gear-tooth loads achieved by slight increase in pitch diameter.

The writer essentially agrees that a carburized and ground-gear train can compete economically with cut gears but wishes to point out that the complications mentioned also should be considered before reaching a final verdict.

Of the photographs in the article by D. W. Botstiber—Manufacturing Methods of Power-Transmission Gears and Their Influence on Design Considerations—Figs. 6 and 7 were obtained through the courtesy of Messrs. W. H. Allen & Sons Ltd., Bedford, England, and represent Allen-Stoeckicht Gears as manufactured under the terms of a Licensing Agreement between W. H. Allen & Sons Ltd. and Mr. Wilhelm Stoeckicht of Munich, Germany.

Challenge in Engineering Education

To the Editor:

Two excellent papers in Mechanical Engineering for November, 1954, point up the challenge in engineering education today. Dr. M. H. Trytten reviews the exponential expansion in quantity, quality, scope, and intensity of "Engineering Education in Russia." The proportion of the total resources devoted to education in the USSR seems higher than in the U. S., except on the local level. Moreover, in the area of graduate degrees (upon whose recipients we much depend for impinging on the frontiers of knowledge) the number of candidates and their collective abilities must be nearly equal.

Existing Basic Conflicts

No more concise and clear presentation of the "Basic Conflicts in Engineering Education" in this country than the article by Dr. Arthur Bronwell has appeared recently. Not only the educators, but the people of the nation, are confronted by a whole concatenation of unhappy circumstances brewing to diminish the effectiveness of engineering education. A few might be mentioned: Increased percentage of high-school graduates attempting to enter engineering curricula with poor preparation in secondary-school mathematics, physics, and chemistry; pressure on engineering faculties to include more cultural and broadening subjects in the curricula; an obvious necessity for additional fundamental courses in mathematics and the basic sciences; a desire to incorporate new theories, ideas, and techniques into advanced design courses; the difficulty of recruiting top-notch professorial staffs on the budgets available, and a policy of the national Selective Service system which prevents proper utilization of young engineering talent where it is urgently needed. But not all of the foregoing distractions to engineering are inherently bad by themselves. Just recently the National Council for the Social Studies was told[6] that as many as 65 per cent of our high-school students have not had a course in world geography or world history. And there are other desirable subjects contributing to good citizenship which high schools need to offer. But these combinations of acceptable individual goals will not always lead to an effective program in engineering.

[6] See editorial in *The New York Times*, Sunday, Nov. 28, 1954.

What should be done about the situation was wisely omitted from their papers by Dr. Trytten and Dr. Bronwell. However, the engineer is accustomed to making decisions about design, production, or management even though he does not have all the facts. His judgment reflects his training and experience and enables him to project ahead and come up with a reasonable answer. He cannot wait until all is known about the loads and stresses, or the cost and production. Likewise, technology cannot wait until these basic conflicts have been adjudicated, nor can it expect a national policy on education, as has been established in Russia.

Questions That Need Answers

The engineering colleges need to get together and agree on a policy to improve education and present a united front to future students and industrial employers. Some of the questions which need answers are: (*a*) Shall admission requirements be raised, thus severely limiting enrollment? (*b*) Shall admission be conditioned only upon passing entrance examinations, thus encouraging the examination-passing attitude rather than the learning? (*c*) Shall we require one or two years of pre-engineering in liberal arts with (or without) a major in basic sciences, as is now done in other professional colleges, viz., law, dentistry, medicine, veterinary medicine, pharmacy, etc.? (*d*) Shall we curtail instruction in engineering subjects, trim our courses to the available length of curricula, and stick to bare fundamentals at a time when scientific technology is rapidly expanding? (*e*) Shall we cut fundamentals and teach formula routines, approaching the technical-institute philosophy? (*f*) Shall we consider the essentials of engineering for future engineers and increase the length of engineering curricula beyond four years to fit the requirements of subject matter, as has been done in other professions?

There are many objections to most of the foregoing alternatives, but under (*f*) the engineering colleges would control the educational program and could plan a co-ordinated sequence of studies and integrate the courses to satisfy the future needs of the nation.

Samuel B. Folk.[7]

[7] Professor of Engineering Mechanics, The Ohio State University, Columbus, Ohio. Mem. ASME.

Comment by E. C. Koerper[8]

The timely paper by Dr. M. H. Trytten is partial recognition of where we stand in the international race for technical supremacy. Trained manpower is the most critical factor involved.

Trends determine historical events. Where will we stand five or ten years from now?

The implications are deep because they bring into sharp focus the hazy and indifferent approach, we, as a nation, have had on the following problems; these are all vital to both our successful peacetime and wartime operation:

1 Selecting and aiding outstanding students for higher education.

2 Deferment of such students from military service.

3 Better utilization of trained professional men.

4 Graduate more technicians—we get less than $^1/_{25}$ of those we need.

5 Better utilization of technicians.

Engineers are in the best position to see this situation clearly. It is, therefore, our responsibility to start working aggressively toward correcting it.

[8] Technical Director, E. C. Koerper Associates, Milwaukee, Wis. Assoc. Mem. ASME.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Strength and Resistance of Metals

Strength and Resistance of Metals. By John M. Lessells. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, Ltd., London, England, 1954. Cloth, 6 × 9 in., xiv and 450 pp., 220 illus., $10.

Reviewed by T. J. Dolan[1]

The principal purpose intended for this volume on the strength of metals was to provide advanced undergraduate and graduate students, as well as design engineers, with factual information and rational knowledge of the behavior of metals under stress. The text is liberally dispersed with references to the major source material from which the conditions and behavior patterns have been summarized by the author. Many readers will find some of these old in years, but the author has selected with care to include outstanding contributions rather than the latest references in each portion of the subject matter. The majority of the discussions center upon the behavior of steel as the primary metal used in engineering products, though mention is made of nonferrous alloys and cast iron under conditions for which their behavior is markedly different from that of steel. In expressing formulas for comparing stresses and strains with mechanical behavior, the author has limited the discussions to simple formulas in mechanics. The principal concepts are those of the observed material behavior rather than the hypothetical or analytical approach.

Particular emphasis is placed upon the subject of fatigue in metals, to which the author attributes the majority of failures of engineering components, though other types of failure such as creep and fracture at elevated temperatures, and brittle fracture at low temperature are also given due attention.

The first two chapters cover the tensile test not only as an acceptance criterion but also discuss the newer concepts of "true" stress-strain characteristics, effect of testing speed, and significance of the data to designers. The effects of overstrain, cold working, hysteresis, and residual stresses on metals are appraised in detail. Chapter 3 covers both short-time and long-time high-temperature tests and the utilization of creep data in engineering design. Chapter 4 outlines the various types of hardness measuring equipment and its importance as an inspection tool. Chapter 5 covers the behavior of metals under impact loading

[1] Head, Department of Theoretical and Applied Mechanics, University of Illinois, Urbana, Ill. Mem. ASME.

with single-blow and repeated-blow tests and the development of brittle fracture below the transition temperature range. Chapters 6, 7, and 8 discuss the numerous controlling factors influencing the fatigue strength of metals such as specimen geometry, environment, types of stressing action, and range of stress. Fractures and failure phenomena are described in detail.

Chapter 9 develops the concepts of strain hysteresis and damping capacity, and chapter 10 covers the general features and nature of mechanical wear, surface fatigue, and the significance of wear testing methods. Chapter 11 includes a brief summary of the theories of strength from the viewpoint of the state of stress producing inelastic deformation and the corresponding allowable working stresses (with factors governing their selection) for various conditions met in service. Several tables of typical mechanical properties of commonly used structural materials are included as a guide in selecting working stresses. Numerous problems on all phases of the subject are placed at the end of the book for use by students.

The author has done a commendable job in attempting to summarize the state of knowledge of material behavior to enable the designer to dispense with empirical formulas and employ rational methods. The author has been careful to point out the significance to the engineer and methods of utilization of the various mechanical properties obtained from laboratory investigations. The specialist in the field may be disappointed at not finding exact methods for solution of the more complex problems such as cumulative damage in fatigue, or for creep under combined stress, and so on. In many instances for which the knowledge of material behavior is not exact, one must still rely upon a combination of theory and experiment for most reliable and economical design. The advanced engineering student or the young engineer will find the book well adapted to bringing him up to date on the facts known about the mechanical-strength properties of metals.

Books Received in Library...

Conveyors and Related Equipment. By Wilbur G. Hudson. John Wiley & Sons, Inc., New York, N. Y., third edition, 1954. 524 p., $9^1/_4 \times 6$ in., bound. $9. This comprehensive treatment of materials handling describes the application of a wide variety of equipment and analyzes the effectiveness of the several kinds. It provides a guide to the factors which must be considered when buying, operating, and maintaining conveyors and other devices. New material is included on dust-explosion hazards, pneumatic conveying, hydraulic transportation of coal in pipe lines, and a number of other subjects.

Design and Analysis of Industrial Experiments. Edited by Owen L. Davies. Hafner Publishing Company, New York, N. Y., 1954. 636 p., $10 \times 6^1/_2$ in., bound. $10. A sequel to the editor's "Statistical Methods in Research and Production" (1947), this book applies some of the simpler techniques discussed in its predecessor to the arrangement of items comprising a complex experiment and to the analysis of results. Problems considered include planning simple comparative experiments, sequential testing, factorial experiments, and determination of optimum conditions. Experimental methods are not dealt with. Although the numerous examples given are drawn exclusively from the chemical industry, basic principles are explained in general terms applicable in other fields.

Engineering Cybernetics. By H. S. Tsien. McGraw-Hill Book Company, Inc., New York, N. Y., 1954. 289 p., $9^1/_4 \times 6^1/_4$ in., bound. $6.50. This study, presented on the mathematical level of the research engineer, is concerned with the parts of cybernetics which have direct engineering applications in designing controlled or guided systems. The emphasis is on theoretical analysis and on the principles underlying different areas of practice rather than on the design and construction of components. Some of the topics treated are noninteracting controls of many variable systems, nonlinear servomechanisms, control design by perturbation theory, noise filtering, and theory of error control.

Engineering Dynamics. Volume 3. Steam Turbines. Volume 4. Internal Combustion Engines. By C. B. Biezeno and R. Grammel. Translated by E. F. Winter and H. A. Havemann. Blackie & Son Ltd., Glasgow, Scotland, 1954. 264 p., 282 p., $10^1/_4 \times 7^1/_4$ in., bound. 40s, 50s. These are the first volumes to be published of a projected four-volume translation of the authors' "Technische Dynamik" (1953), which, as a whole, deals with some of the more difficult problems encountered by practical designers and research engineers. Of the present volumes, volume three discusses in detail various problems relating to rotating disks, turbine blades, and critical speeds of rotation. Volume four covers inertia forces, power smoothing, and torsional vibrations.

Feedback Control Systems. By Gilbert Howard Fett. Prentice-Hall, Inc., New York, N. Y., 1954. 361 p., $8^5/_8 \times 5^7/_8$ in., bound. $10. An introduction to the subject for advanced students and for practicing engineers seeking a basic understanding of the field. The equations of components are developed, and separate chapters are devoted to steady-state and transient solutions, the Nyquist criterion for stability, and stability diagrams. Concluding chapters deal with complex and nonlinear systems. Chapter bibliographies are included.

Fluid Dynamics of Jets. By Shih-I Pai. D. Van Nostrand Company, Inc., New York, N. Y., 1954. 227 p., $9^1/_4 \times 6^1/_4$ in., bound. $5. Intended for advanced students and research workers, this book presents experimental and theoretical data on the steady flow of a jet of gas, issuing from a nozzle into the surrounding stream at rest or in uniform motion. Included is discussion of flow in the potential core, and in the mixing region of a jet of gas, and of laminar flow for jets of both incompressible and compressible fluids. Theoretical methods treated are also applicable to the study of wakes and cavitation. References are listed after each chapter.

Industrial Design. By Harold Van Doren. McGraw-Hill Book Company, Inc., New York, N. Y., second edition, 1954. 379 p., $10^1/_8 \times 7^7/_8$ in., bound. $6.50. This book is aimed at the young person choosing a vocation and also at engineers, draftsmen, and others with design problems to solve. It outlines the principles, techniques, and procedures to be followed in analyzing, creating, and developing products for mass manufacture, including consumer goods, capital goods, commercial or service equipment, and transportation equipment. New chapters have been added on predesign research, independent analysis, merchandising, and testing consumer reaction to a proposed design.

Introduction to Theoretical Mechanics. By Robert A. Becker. McGraw-Hill Book Company, Inc., New York, N. Y., 1954. 420 p., $9^1/_4 \times 6^1/_4$ in., bound. $8. Some special features of this textbook for physics majors and graduate students are brief mention of nonlinear systems in connection with the study of oscillatory motion in one dimension, discussion of the equation of motion for a body in which the mass is varying, and extended treatment of general rigid-body rotations in space. Newtonian mechanics are emphasized except in the last three chapters in which general co-ordinate methods are introduced.

Machine Design. By Vladimir L. Maleev and James B. Hartman. International Textbook Company, Scranton, Pa., third edition, 1954. 706 p., $9^1/_2 \times 6^1/_4$ in., bound. $8.50. The six main divisions of this text deal with stresses and materials, manufacture of machine parts, fastenings, details for handling fluids, hoisting machinery, and power-transmission machinery. Coverage has been extended to include developments in many fields, including the unified screw-thread system, new fastening devices, involute splines, and new materials such as ductile iron and various aluminum alloys. Two new chapters have been added to the section on manufacturing processes.

Manufacture and Application of Lubricating Greases. By C. J. Boner. Reinhold Publishing Corporation, New York, N. Y., 1954. 977 p., $9^1/_4 \times 6^1/_4$ in., bound. $18.50. A comprehensive study covering the structure of lubricating greases; raw materials, processes, and equipment for manufacture; and the various greases derived from each type of thickening agent, such as aluminum, barium, calcium, and lithium soaps, nonsoap agents, etc. Separate chapters are devoted to analysis, testing, applications, and future trends of the industry. The extensive bibliographies given at the end of each chapter include, for the most part, references since 1937.

Oil in the Middle East. By Stephen Hemsley Longrigg. Oxford University Press, New York, N. Y., 1954. 305 p., $8^3/_4 \times 5^3/_4$ in., bound. $4. The major part of this historical and descriptive account of the discovery and exploitation of oil in Persia and the Arabian territories is devoted to the activities of American and other companies since the first world war. Both the practical operations of exploration, discovery, field development, production, transportation, and refining are recorded and the relations between governments, peoples, and the companies described. Appendixes give statistical and other information on production, companies, etc., and maps of fields, drilling sites, and pipe lines are included.

PHYSICAL PROPERTIES OF SOLID MATERIALS. By C. Zwikker. Interscience Publishers, Inc., New York, N. Y., 1954. 300 p., $9\frac{3}{4} \times 6\frac{1}{4}$ in., bound. $8.75. In this attempt to summarize the entire field of solid-state physics in a single volume, coverage ranges from problems such as mechanics and heat, which date back many years, to such problems as electronic properties, which are still in a stage of development. For each topic a résumé of the theoretical foundations is given, and present knowledge is reviewed up to the point where applications can be suggested. The MKS system of units is used throughout, and tables of conversion factors and other data are appended.

PROFITABLE SMALL PLANT MANAGEMENT. By Malcolm H. Gotterer. Conover-Mast Publications, Inc., New York, N.Y., 1954. 318 p., $8\frac{1}{4} \times 5\frac{3}{4}$ in., bound. $5.50. A book of basic principles intended for the manager of small or medium-sized plant. It will be useful to those planning a cost-reduction or management-development program, and to those who must supervise the work of employed specialists, or who wish to acquire a general knowledge of scientific management. Concisely dealt with are plant layout, production control, manpower management, job evaluation, cost control, and other phases of the subject.

RADIANT HEATING. Including Cooling and Heat-pump Applications. By Richard Woolsey Shoemaker. McGraw-Hill Book Company, Inc., New York, N. Y., second edition, 1954. 346 p., $9\frac{1}{4} \times 6\frac{1}{4}$ in., bound. $7. Of interest to contractors, heating engineers, and architects, this book, somewhat enlarged in the second edition, contains data on applications, design, and installations for private homes, factories, and public buildings. Also treated are radiant heating for snow melting, heating of swimming pools, use of the heat pump, and heating by direct use of electricity. Operating and installation costs are discussed.

SOME BASIC PROBLEMS OF THE MATHEMATICAL THEORY OF ELASTICITY. By N. I. Muskhelishvili. Translated by J. R. M. Radok. P. Noordhoff, Ltd., Groningen, Holland, third edition, 1953. 704 p., $9\frac{1}{4} \times 6\frac{1}{4}$ in., bound. 38Fl. In a foreword, I. S. Sokolnihoff describes this book as one of the most significant contributions to the subject since Love's "Treatise." The main topics treated are fundamental equations of an elastic body; general formulas of the plane theory of elasticity; solution of plane-theory problems by power series; Cauchy integrals and their application to the solution of boundary problems; solution of the boundary of the plane theory by reduction to the problem of linear relationship; and extension, torsion, and bending of bars. The translator has supplied a subject index and an author's index to the original list of references.

TIME-SAVER STANDARDS. An Architectural Record Book. F. W. Dodge Corporation, New York, N. Y., third edition, 1954. 888 p., $11\frac{1}{4} \times 8\frac{3}{4}$ in., bound. $12.50. Essential information for architectural drafting, designing, and specification writing is presented in this manual in condensed graphic style. The six sections provide readily usable information on office practice, structural design, residential and nonresidential design elements, site planning, landscaping, and building materials and equipment. Some of the material in the previous edition has been eliminated and more than a hundred pages have been added.

TWINNING AND DIFFUSIONLESS TRANSFORMATIONS IN METALS. By E. O. Hall. Butterworths Scientific Publications, London, England, 1954. 181 p., $8\frac{7}{8} \times 5\frac{5}{8}$ in., bound. 30s. The major part of the book is devoted to the crystallography of twinning, twin-formation theories, and the formation of twins by heat-treatment and under stress. One chapter covers diffusionless transformations, and there are introductory chapters dealing with elementary crystallography, stereographic projection, and the growing of single crystals. References are listed after each chapter.

DER ULTRASCHALL. Und Seine Anwendung in Wissenschaft und Technik. By Ludwig Bergmann. S. Hirzel Verlag, Zürich, Switzerland, second edition, 1954. 1114 p., 9×6 in., bound. 72 Sw.Fr. This monograph is a comprehensive review of the current state of ultrasonics research. A new chapter on the physics of sound has been added at the beginning of the present edition and many chapters have been revised or rewritten to incorporate new material. The bibliography now consists of over 5000 references.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

THE Boiler and Pressure Vessel Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting December 10, 1954, and approved by the Board on February 2, 1955.)

CASE No. 1173-1 (REOPENED)

(Special Ruling)

In the *Reply*, Par. (9), revise the bolting stresses as follows:

100	200	300	400	500	600	650
11200	10000	9800	9100	8800	8300	8300

CASE No. 1196

(Special Ruling)

Inquiry: May aluminum bronze alloy 9A of ASTM Specification B 148-52 be used in the construction of vessels under the requirements of Section VIII of the Code, when it is centrifugally cast in accordance with ASTM Specification B 271-52T and meets the following requirements for mechanical properties?

The minimum tensile requirements conform to the following:

Tensile Strength	80,000 psi
Yield Strength at 0.5 per cent elongation under load	29,000 psi
Elongation in 2 in.	30 per cent

Reply: It is the opinion of the Committee that the material specified in the Inquiry may be used in the construction of unfired pressure vessels under the rules of Section VIII provided the following additional requirements are complied with:

(1) The maximum allowable stress values shall be those given in Table 1.

(2) Welding procedures and welders shall be qualified in accordance with Section IX, Part B. Separate qualifications are required for this material since it is not listed in Table QN-11.1.

(3) The requirements in Par. UNF-65 shall apply to low-temperature operation.

CASE NO. 1196—TABLE 1 MAXIMUM ALLOWABLE STRESS VALUES

Metal Temp Not Exceeding Deg F	Allowable Stress Value, Psi
150	17,000
250	14,300
300	14,000
350	13,700
400	13,600
450	13,500
500	13,000

NOTE: The allowable design stresses are subject to a casting factor as per Pars. UNF-8 and UG-24.

NONMANDATORY APPENDIX

(1) Since this alloy will be employed in the processing or storage of corrosive liquids or gases, care should be exercised that the design considers the corrosion possibilities. All crevices where accelerated local attack may occur should be filled or sealed by fusion welding. These crevices usually are found behind backing strips, lap joints, or riveted joints.

(2) It is expected that vessels or parts thereof constructed from the above cast materials will be employed in the processing or storage of corrosive liquids or gases. The selection of materials as being suitable in a specific application shall be the responsibility of the user.

(3) The determination of corrosion al-

lowances is not covered by these rules. It is recommended that users assure themselves by appropriate tests or otherwise that the alloy is suitable for the service intended.

(4) The acceleration of corrosion by the presence of internal stresses or failure by stress corrosion should be considered by the user. Where service data are not available it is recommended that a suitable thermal treatment be employed after fabrication has been completed. This treatment includes a furnace anneal, when practical, at a temperature of 1150 F for a period of 1 to $1^1/_2$ hours at temperature. Air cooling from the furnace temperature is completely satisfactory.

Case No. 1197

(Special Ruling)

Inquiry: In view of the recent change in Appendix Q which permits the same policy for determining bolting stresses for nonferrous materials as is now in effect for ferrous materials, what design stresses may be used in place of those now appearing in Table UNF-23?

Reply: It is the opinion of the Code Committee that the bolting stresses in the accompanying table may be used in place of those now in Table UNF-23.

Case No. 1200

(Special Ruling)

Inquiry: May wrought-iron plates meeting the requirements of ASTM Specification A-42-52T be used in the construction of unfired pressure vessels under the rules of the 1952 Edition of Section VIII of the ASME Boiler and Pressure Vessel Code?

Reply: It is the opinion of the Committee that this material may be used for unfired pressure vessels under the provisions of the 1952 Edition of Section VIII with the following limitations and additional requirements:

(1) Each plate shall be stamped with the maker's brand or name, the ASTM specification number, the minimum specified tensile strength of 39,000 psi, the minimum elongation in 8 in., and the lot number or test-identification number.

(2) The maximum allowable stress value shall be 9750 psi.

(3) The maximum metal temperature in vessel operation shall be 650 F.

(4) The mill-test reports shall show the tensile strength and elongation both longitudinally and transversely.

(5) *(a)* Special forming plate shall meet the requirements of Section IX of the Code except that the guided bend-test specimen shall be machined on the compression side to a thickness of $^3/_{16}$ in. but shall be bent in the standard guided bend-test jig for specimens $^3/_8$ in. thick.

(b) Standard plate shall meet the requirements of Section IX of the Code except that the guided bend-test specimens shall be made with the welds perpendicular to, and the direction of bending parallel to, the direction of rolling of the plate. The standard $^3/_8$-in-thick specimen shall be used.

Annulment of Cases

Case Nos.	Reason for Annulment
973	Pars. P-186(h) and UW-27(2) permit the use of oxyacetylene pressure welding.
1116	Lack of use.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code. . .

As need arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If, and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers, 1952

Par. P-102(h)(2)(a) Revise table to read:

Plate Thickness, In.	Thickness of Reinforcement, In.
Up to $^1/_2$, incl.	$^1/_{16}$ max
Over $^1/_2$ to 1, incl.	$^3/_{32}$ max
Over 1 to 2, incl.	$^1/_8$ max
Over 2	$^5/_{32}$ max

Par. P-102(h)(9) Revise the first sentence to begin: "When radiographing a circumferential joint by placing the radiation source inside the vessel or pipe . . . ."

Par. P-102(h)(9) Revise the first two lines of the footnote to read: "A suggested method for proving the adequacy of the radiographic method is as follows:"

Revise the fourth sentence of the footnote to begin: "The radiation source employed in making this proof radiograph together with all other items of technique such as the location of the source of radiation and time of exposure . . . ."

Par. P-102(h)(10) Revise the first line to begin: "When the radiation source is placed on the axis . . . ."

Par. P-258 In the fifth paragraph, revise the size of handhole opening to read: "$2^3/_4$ by $3^1/_2$ in."

Par. P-270 Revise the last line to read: The safety-valve capacity of new units shall be in compliance with Par. P-274 but shall not be less than the maximum designed steaming capacity as determined by the manufacturer.

Par. P-273(d) In the first line, delete the words "After obtaining the Code stamp . . . ."

Material Specifications, 1952

The Boiler and Pressure Vessel Committee has approved adding to Section II the following new specifications:

Plates

SA-6-54T	SA-225-54T
SA-20-54T	SA-240-54
SA-30-54T	SA-285-54T
SA-129-54T	SA-299-54T
SA-167-54	SA-300-54aT
SA-201-54T	SA-301-54aT
SA-202-54T	SA-302-54T
SA-203-54T	SA-353-54T
SA-204-54T	SA-357-54T
SA-212-54aT	

Tubular Products

SA-53-54T	SA-249-54T
SA-83-54T	SA-250-54T
SA-135-54T	SA-268-54
SA-178-54T	SA-271-54
SA-192-54T	SA-312-54T
SA-209-54T	SA-333-54T
SA-210-54T	SA-334-54T
SA-213-54T	SA-376-54T
SA-226-54T	

Nonferrous Materials

SB-11-54	SB-98-54
SB-12-54	SB-111-54
SB-42-54	SB-152-54
SB-43-54	SB-171-54
SB-75-54	SB-211-54T
SB-96-54	SB-225-53T

SB-178-54T (except alloy GM40A)
SB-247-54T (except alloys CN42C, CN42D, SG121A, SG11A, ZG62A, 990A)
SB-273-54T (alloys GS11A and CG42A only)
SB-274-54T (alloys M1A, Clad M1A, GS10A and GS11A only)
SB-285-54T (except alloys R-C4A, R-CN42A, R-CS41A, E-CS41A, R-ZG61A)
SB-295-54T (except alloys, E-3N14, E-3N19)

The Boiler and Pressure Vessel Committee has approved the deletion from Section II of the following specifications:

SB-26	SB-108

CASE NO. 1197—MAXIMUM ALLOWABLE STRESS VALUES IN TENSION FOR NONFERROUS BOLTING METALS, PSI

ALUMINUM AND ALUMINUM ALLOYS

Spec. No.	Alloy	Temper	Specified Minimum Tensile Strength, psi	Specified Minimum Yield Strength, psi	Notes	For Metal Temperatures Not Exceeding, Deg F: 100	150	200	250	300	350	400
SB-211	GS11A	T6	42,000	35,000	7	8,400	8,100	7,700	7,100	6,000	4,800	3,400
SB-211	CG42A	T4	62,000	40,000	7	10,000	9,700	9,400	9,000	7,800	6,200	4,600
SB-211	CS41A	T6	65,000	55,000	7	13,000	12,200	11,600	10,400	7,200	4,400	3,000

Note 7. See Paragraphs UNF-12 and UNF-23.

COPPER AND COPPER ALLOYS

Spec. No.	Material	Condition	Size, in.	Specified Minimum Tensile Strength, psi	Specified Minimum Yield Strength, psi	For Metal Temperatures Not Exceeding, Deg F: 150	250	300	350	400	450	500	550	600	650	700
SB-12	Copper	Soft	All	30,000	10,000	2,500	2,400	2,200	2,100	2,000						
SB-98	Copper-Silicon	Soft	All	52,000	15,000	3,800	3,800	3,800	3,500							
	Alloys A & D (1)	Quarter Hard	All	55,000	24,000	6,000	5,800	5,600	5,500							
		Half Hard	All	70,000	38,000	9,500	9,000	8,800	8,500							
SB-98	Copper-Silicon	Soft	All	40,000	12,000	3,000	3,000	2,900	2,800							
	Alloy B (1)	Bolt Temper	Up to $^1/_2$, incl.	85,000	55,000	13,800	13,100	12,700	12,300							
			Over $^1/_2$ to 1, incl.	75,000	45,000	11,200	10,800	10,500	10,000							
			Over 1 to 1$^1/_2$, incl.	75,000	40,000	10,000	9,600	9,400	9,000							
SB-150	Aluminum	...	Up to $^1/_2$, incl.	80,000	40,000	10,000	9,900	9,800	9,800	9,700	9,500	9,400	9,000	7,500	6,000	4,500
	Bronze	...	Over $^1/_2$ to 1, incl.	75,000	37,500	9,400	9,200	9,200	9,100	9,000	8,900	8,800	8,600	7,500	6,000	4,500
	Alloy No. 1	...	Over 1	72,000	35,000	8,800	8,600	8,600	8,500	8,400	8,300	8,200	8,000	7,500	6,000	4,500
SB-150	Aluminum	...	$^1/_2$ to 1, incl.	100,000	50,000	12,500	12,500	12,400	12,400	12,300	12,200	12,000	10,500	9,000	7,500	6,000
	Bronze	...	Over 1 to 2, incl.	90,000	45,000	11,200	11,200	11,200	11,200	11,100	11,000	10,800	10,500	9,000	7,500	6,000
	Alloy No. 2	...	Over 2 to 4, incl.	85,000	42,500	10,600	10,600	10,600	10,500	10,500	10,400	10,200	10,000	9,000	7,500	6,000
SB-150	Aluminum	...	Up to $^1/_2$, incl.	80,000	40,000	10,000	9,900	9,800	9,700	9,600	9,500	7,000				
	Bronze	...	Over $^1/_2$ to 1, incl.	75,000	35,000	8,800	8,700	8,600	8,600	8,400	8,300	7,000				
	Alloy No. 3	...	Over 1 to 2, incl.	70,000	32,000	8,000	7,800	7,800	7,600	7,600	7,400	7,000				

Note 3. See Pars. UNF-12 and UNF-23.

NICKEL AND NICKEL ALLOYS

Spec. No.	Material	Condition	Specified Minimum Tensile Strength, psi	Specified Minimum Yield Strength, psi	For Metal Temperatures Not Exceeding, Deg F: 80	100	200	300	400	500	600	700	800	900	1000	1100	1200
SB-160	Nickel	Hot or Cold Worked—Annealed	55,000	15,000	3,700	3,700	3,700	3,700	3,700	3,700	3,700						
		Hot Rolled or Forged—Hot Finished	60,000	15,000	3,700	3,700	3,700	3,700	3,700	3,700	3,400						
SB-160	Low-Carbon Nickel	Hot Worked or Annealed	50,000	10,000	2,500	2,500	2,400	2,300	2,300	2,300	2,300	2,300	2,200	2,100	2,000	1,800	1,200
SB-164	Nickel—Class A & B	Hot or Cold Worked—Annealed	70,000	25,000	6,200	6,100	5,700	5,200	5,000	4,900	4,900	4,900	4,900	4,700			
	Copper—Class A	Hot Rolled or Forged—Hot Finished (3)	80,000	40,000	10,000	10,000	9,600	9,400	9,000	8,500	8,500	8,500	8,300	4,000			
	Class A	Cold Drawn—As Drawn (4) (5)	90,000	70,000	17,500	17,400	16,900	16,200	15,500	15,400							
	Class B	Cold Drawn—As Drawn (4) (5)	85,000	50,000	12,500	12,400	12,000	11,500	11,100	11,100							
SB-166	Nickel	Hot or Cold Worked—Annealed	80,000	30,000	7,500	7,300	6,900	6,800	6,800	6,800	6,800	6,800	6,500	6,300	6,000	3,000	2,000
	Chromium-Iron	Hot Rolled or Forged—Hot Finished	85,000	35,000	8,800	8,700	8,500	8,200	8,000	7,900	7,900	7,900	7,700	7,400	7,300	7,200	5,500

Note 4. See Pars. UNF-12 and UNF-23.
Note 5. Safe operating temperature arbitrarily set at 500 F maximum because of lack of data.

Low-Pressure Heating Boilers, 1952

Pars. H-44(a) and H-97(a) Revise to read:

(a) Each hot-water heating boiler shall have at least one officially rated pressure relief valve set to relieve at or below the maximum allowable working pressure of the boiler. Each hot-water supply boiler shall have at least one officially rated relief valve or at least one officially rated pressure-temperature relief valve of the automatic-reseating type set to relieve at or below the maximum allowable working pressure of the boiler. When more than one relief valve is used on either hot-water heating or hot-water supply boilers, the additional valve or valves shall be officially rated and may be set within a range not to exceed 20 per cent of the lowest pressure to which any valve is set. Relief valves shall be spring loaded without disk guides on the pressure side of the valve. Relief valves shall be so arranged that they cannot be reset to relieve at a higher pressure than the maximum permitted by this paragraph.

Pars. H-44(c) and H-97(c) Revise to read:

(c) Seats and disks of relief valves shall be of material suitable to resist corrosion. No materials liable to fail due to deterioration or vulcanization when subject to saturated steam temperature corresponding to capacity test pressure shall be used for any part.

Pars. H-44(e) and H-97(e) Revise to read:

(e) The required steam-relieving capacity, in pounds per hour, of the pressure-relieving device or devices on a boiler shall be determined by dividing the maximum output in Btu at the boiler nozzle obtained by the firing of any fuel for which the unit is designed by 1000 or by multiplying the square feet of heating surface by 5. In many cases a greater relieving capacity of valves will have to be provided than the minimum specified by these rules. In every case, the requirements of (g) shall be met.

Par. H-51(a)(4) Add the words "in accordance with Par. H-51(d)."

Par. H-51(d) Delete the words "After obtaining the Code stamp."

Par. H-51(d) and H-104(d) Revise to read:

(d) The manufacturer of the valves that are to be stamped with the Code symbol shall submit valves for testing to a place where adequate equipment and personnel are available to conduct pressure and relieving-capacity tests which shall be made in the presence of and certified by an authorized observer. The place, personnel, and authorized observer shall be approved by the Boiler and Pressure Vessel Committee. The valves shall be tested in one of the following three methods:

(1) *Coefficient Method.* Tests shall be made to determine the lift, popping, and blowdown pressures, and the capacity of at least three valves each of three representative sizes (a total of nine valves). Each valve of a given size shall be set at a different pressure. A coefficient shall be established for each test as follows:

$$K_D = \frac{\text{Actual steam flow}}{\text{Theoretical steam flow}} = \begin{array}{c}\text{Coefficient}\\ \text{of discharge}\end{array}$$

The average coefficient of the tests required shall be taken as the coefficient (K) of the design and shall be used for determining the relieving capacity of all sizes and pressures of the design in the following formulas:

For 45-deg seat $W = (51.45 \times \pi DLP \times 0.707 \times K)\,0.90$

For flat seat $W = (51.45 \times \pi DLP \times K)\,0.90$

For nozzle $W = (51.45 \times AP \times K)\,0.90$

Where W = weight of steam per hour, pounds
D = seat diameter, inches
L = lift, inches
P = absolute pressure, pounds per square inch (accumulated)
K_D = coefficient of discharge for a single test
K = average coefficient of discharge
A = nozzle-throat area, square inches.

Note: The maximum and minimum coefficient determined by the tests of a valve design shall not vary more than plus or minus 10 per cent from the average.

(2) *Curve Method.* If a manufacturer wishes to apply the Code symbol to a design of relief valves or steam safety valves, four valves of each pipe size and/or orifice size shall be tested. These four valves shall be set at pressures that will cover the approximate range of pressure for which the valves will be used. The capacities as determined by these four tests shall be plotted against the absolute accumulation test pressure and a curve drawn through these four points. If the four points do not establish a reasonable curve the authorized observer shall require additional valves tested. From this curve the relieving capacities shall be obtained. The stamped capacity shall be 90 per cent of the capacity taken from the curve.

(3) If a manufacturer wishes to apply the Code symbol to pressure-relief valves or steam safety valves of one or more sizes of a design set at one pressure, he shall submit three valves of each size of each design set at one pressure for testing and the stamped capacity of each size shall be 90 per cent of the average capacity of the three valves tested.

Pars. H-51(e) and H-104(e) Revise to read:

(e) Safety valves for steam boilers shall be tested for capacity at $33^1/_3$ per cent over the 15 psi required set pressure. Capacity certification tests of relief valves for hot-water heating and hot-water supply boilers shall be conducted at 110 per cent of the pressure for which the valve is set to operate.

For the purpose of determining the capacity of pressure-temperature relief valves, dummy elements of the same size and shape as the regularly applied thermal element shall be substituted and the relieving capacity shall be based on the pressure element only. The thermal element for a pressure-temperature relief valve shall be so designed and constructed that when subjected to steam temperature at test pressure, it will not fail in any manner which could obstruct flow passages or reduce capacity.

To determine the discharge of relief valves in terms of Btu, the relieving capacity in pounds per hour (W) is multiplied by 1000.

Pars. H-51(f) and H-104(f) Revise to read:

(f) The tests shall be made with steam in a manner closely approximating actual operating conditions of steam boilers. The relieving capacity shall be measured by condensing the steam or with a calibrated steam flowmeter.

Pars. H-51(h) and H-104(h) Delete.

Par. H-104(a)(4) Add the words "in accordance with Par. H-104(d)."

Par. H-104(d) In the first line, delete the words "After obtaining the Code stamp."

Unfired Pressure Vessels, 1952

Par. UG-131(a) Delete the words "After obtaining the Code-symbol stamp, as outlined in Par. UG-130, but."

Par. UG-47 Reletter the present subparagraph (c) and subsequent subparagraphs as (d), (e), etc., and add a new subparagraph (c):

(c) If a stayed jacket extends completely around a cylindrical or spherical vessel, or completely covers a formed head, it shall meet the requirements given above in (a), and shall also meet the applicable requirements for shells or heads in Pars. UG-27(c) and (d) and UG-32.

Par. UG-27 Add the following subparagraph:

(f) A stayed jacket shell that extends completely around a cylindrical or spherical vessel shall also meet the requirements of Par. UG-47(c).

Par. UG-32 Add the following subparagraph:

(r) A stayed jacket that completely covers a formed inner head of any of the types included in this paragraph shall also meet the requirements of Par. UG-47(c).

Par. UW-11(c)(2) Add the following subparagraph:

(c) Circumferential welded butt joints between a radiographed shell section and a nonradiographed head, the design thickness of which is less than that of the shell section except as required in Par. UW-11(a).

Welding Qualifications, 1953

Pars. Q-20(b) and QN-20(b) Add as a new subparagraph (b):

(b) The welder performance test may be terminated at any stage of the testing procedure whenever it becomes apparent to the supervisor conducting the tests that the welder does not have the required skill to produce satisfactory results. In this event, the welder may be tested at the discretion of the manufacturer in accordance with Pars. Q-21 and QN-21.

Reletter present Pars. Q-20(b) and QN-20(b) as Q-20(c) and QN-20(c), respectively.

ASME NEWS

With Notes on the Engineering Profession

Two Major Meetings in April Highlight ASME Diamond Jubilee Year Celebration

♦ Organization Anniversary Meeting; April 16, Hoboken, N. J.
♦ Diamond Jubilee Spring Meeting; April 18–22, Baltimore, Md.

Two major meetings are scheduled in April commemorating the 75th Anniversary of The American Society of Mechanical Engineers. The first of these is the Organization Anniversary Meeting to be held in Hoboken, N. J., on April 16. The second is the ASME Diamond Jubilee Spring Meeting to be held in Baltimore, Md., April 18 through 22.

♦ Organization Anniversary Meeting

The ASME Organization Anniversary Meeting will be held on the campus of the Stevens Institute of Technology, Hoboken, N. J., Saturday, April 16, 1955. This meeting will commemorate the first organization meeting of the Society held in the Assembly Hall at Stevens Tech in Hoboken on April 7, 1880.

The Organization Meeting grew out of the Founding Meeting held on February 16 of the same year. It was attended by 85 persons. At this meeting, the Society's organization was formerly established and the first slate of officers elected, with Prof. Robert H. Thurston as the Society's first President.

The Engineer and the World of Education

The theme of the Organization Anniversary Meeting will be "The Engineer and the World of Education." The morning session, in the original Assembly Hall, will be devoted to a brief commemorative ceremony. Delegates of engineering societies and joint bodies, universities and colleges, and engineering fraternities will pay tribute to ASME. After a luncheon on the campus, the meeting will reconvene and prominent speakers will discuss various aspects of "The Engineer and His Communications." The afternoon speakers will include Mervin J. Kelley, president of Bell Telephone Laboratories; Blake R. Van Leer, Fellow ASME, president of the Georgia Institute of Technology; C. Richard Soderberg, dean of engineering, Massachusetts Institute of Technology; and H. Rowan Gaither, Jr., president and director, The Ford Foundation. In keeping with the decentralized celebration of the 75th ASME Anniversary, some of the Society's major honors and awards will be conferred. These will include the ASME Medal, the ASME George Westinghouse Gold Medal, and one or more Honorary Memberships.

♦ ASME Diamond Jubilee Spring Meeting

The ASME Diamond Jubilee Spring Meeting, to be held at the Lord Baltimore and Southern Hotels, Baltimore, Md., April 18–22, will feature the future while honoring the past. The program has been planned in same pioneering, forward-looking spirit that characterized the founders of ASME 75 years ago. With the American Rocket Society participating with a series of interesting papers, and with sessions sponsored by the ASME Aviation Division, the Spring Meeting will present a forward look.

The technical program will be extensive. Panel discussions will feature the engineer's responsibilities to his Government. The Social activities will be in true Baltimore style; starting with a reception on April 17 and including a tea dance, a banquet, and an oyster roast. A group of varied and interesting inspection trips has been arranged.

Technical Sessions

More than 90 papers will be presented in some 37 technical sessions, ranging through the fields of nearly all of the professional divisions. In addition, sessions will embrace education and nuclear energy. The sessions on aviation will cover such subjects as aerial refueling, thrust reversal, and improving low-speed performance of high-speed aircraft. The sessions sponsored by the American Rocket Society will include papers on manned-rocket vehicles, rocket-test vehicles, and instrumentation in the rocket field. The papers to be presented at the various sessions on machine design, metal processing, materials handling, and production engineering cover a wide range of interesting subjects. The Power Division has organized sessions at which papers will be presented on marine practice, treatment of cooling water, and steam-power-plant practice. Papers on calculation of heat transfer will be presented at a session under the sponsorship of the Heat Transfer Division.

As the general theme of the meeting will be "The Engineer and the World of Government," three sessions will be devoted to the subject. One session, sponsored by the Committee on Education, will include papers on engineers in government and the citizenship responsibilities of engineers. Two panel discussions are planned on this theme: One on "The Engineer's Responsibility in Government," and the other on "The Engineer and the Prospects for Peace." Prominent speakers will participate in these panel discussions. Various points of view will be presented, including national defense, government operations, government policies, and training and utilization of engineers in the communist and the western worlds.

Papers on aircraft instrumentation are included in a session jointly sponsored by the Instrument and Regulators and Aviation Divisions. The papers sponsored by the Fuels Division will cover the specialized uses of gas as fuel. Papers presented at the session on safety will discuss auto-crash survival. Sessions on Nuclear Energy will consider nuclear power and the requirements for metals used in connection with the utilization of the principles of nuclear fission in industry.

Entertainment

A social gathering has been organized by the newly formed but active Woman's Auxiliary to the Baltimore Section, ASME, before the program begins. As many attending the Diamond Jubilee Spring Meeting will arrive on Sunday, April 17, all are urged to be present at a reception from 5:00 to 7:00 p.m., as guests of the Auxiliary, in the Ballroom of the Southern Hotel. This affair is being planned by Mrs. Louis E. Carter.

Another informal affair to promote fellowship is a Tea Dance which will be held in the Caswell Room of the Lord Baltimore Hotel,

Aerial view shows, *foreground,* the Stevens Institute of Technology, Hoboken, N. J. Arrow points to Administration Building of the Institute, where, in the Assembly Hall, the first Organization Meeting of ASME was held on April 7, 1880. The morning session of the ASME Organization Diamond Jubilee Anniversary Meeting will be held on April 16, 1955.

under the direction of Mrs. George S. Harris and Mrs. Raymond C. Dannettel, from 5:00 to 7:00 p.m., on Monday, April 18.

On Tuesday evening, April 19, at 6:30 p.m., the customary banquet will be held in the Ballroom of the Lord Baltimore Hotel. In commemorating the Diamond Jubilee, and in keeping with the theme of this meeting "The Engineer and the World of Government," an invitation has been extended to President Eisenhower to be the banquet speaker.

On Wednesday at 6:30, p.m., one of Maryland's unique delights will be held, at the Alcazar—a convocation known as the "oyster roast." At this our members and guests will have the opportunity of partaking of a large quantity of Chesapeake Bay's famous product, the oyster, in its various delectable forms. One cannot categorize the oyster roast with such less stimulating "alien feastings" as the clambake or fish fry. The oyster roast is a ritual that is the product of Maryland tradition. Our vistors will be introduced to gustatory delight—the raw oyster. The adjacent liquid refreshment headquarters will provide the necessary lubrication to insure the maximum appreciation of the raw oyster and its accompanying sauces. Following there will be the oyster stew, the fried oyster, and the oyster fritter. Side dishes such as steamed shrimp and salads complete the caloric input. All this and the opportunity to circulate among old friends and accumulate new friends, through the art of conversation and fine fellowship, gives the Maryland oyster roast its traditional sauce piquante.

Special Events

At the President's Luncheon on Monday, April 18, ASME President David W. R. Morgan will be the speaker. At the Management Luncheon on Tuesday, April 19, H. B. Maynard, president, Methods Engineering Council, Pittsburgh, Pa., will deliver an interesting message. The American Rocket Society Luncheon on Wednesday, April 20, will keynote a review of the past 25 years of progress in rocket development by the speaker, G. Edward Pendray, of Pendray and Company, New York.

On Thursday evening, April 21, the Glenn L. Martin Company has invited ASME and ARS members, registered at the meeting, on a first-come first-served basis, to be guests of the Company at a dinner at the Lord Baltimore Hotel. The speaker will be E. H. Uhl, vice-president, engineering, G. L. Martin Co., who will discuss "The Engineer and the Aviation Industry." In addition, there will be a display of pertinent equipment.

Junior Meeting

Under the auspices of the National Junior Committee, a meeting will be held on Monday evening, April 18. The meeting will feature "The Engineer as a Public Employee." A representative from each section of Region III will attend as a guest of the Old Guard.

Inspection Trips

A program of inspection trips has been arranged. To insure the accommodation of all who desire to attend and have not made previous reservations, it is urged that arrangements be made at the Inspection Trips Desk immediately after registering. The following trips are planned:

Tuesday, April 19—Morning

Mt. Clare Shops and Transportation Museum of Baltimore and Ohio Railroad. (Also Women's Program.)

Wednesday, April 20—Afternoon

Trip A: **Chevrolet and Fisher Body Divisions of General Motors Corporation.**

Trip B: **Gunther Brewing Company. Inspection of brewery. A cold buffet supper will be served.**

Thursday, April 21—Morning

Riverside Generating Station of Consolidated Gas Electric Light and Power Company of Baltimore.

Friday, April 22

Trip A: **Aberdeen Proving Grounds. Ballistics research laboratory, wind tunnel, and computing laboratory. Luncheon at Proving Ground.**

Trip B: **U. S. Naval Academy, Naval Engineering Experiment Station. Luncheon at Naval**

Academy. In connection with Women's Program, on arriving at the Experiment Station, the ladies will continue on to Annapolis for a tour of historical homes. All will lunch together and then visit the Naval Academy.

Women's Program

A complete program for the women has been prepared under the chairmanship of Mrs. Ernest H. Hanhart with Mrs. R. Wade Seniff as co-chairman. In addition to the reception on Sunday and the Tea Dance on Monday, a morning coffee hour at the Lord Baltimore Hotel has been arranged. On Wednesday, there will be a luncheon and card party at the Baltimore Country Club, arranged by the Woman's Auxiliary to the Baltimore Section. On Friday, an all-day trip to Aberdeen Proving Grounds or Annapolis will be held. In the morning Colonial Annapolis with its historical homes will be toured. After lunch with the men, who have visited the Naval Engineering Experiment Station, all will visit the Naval Academy.

Technical Program

The tentative program follows:

MONDAY, APRIL 18

8:00 a.m.

Registration

9:30 a.m.

Aviation (I)

Less Ground—More Air[1]

Refueling in Flight for Air Defense[1]

Aerial Refueling With the Boeing Flying Boom[1]

9:30 a.m.

Education

Engineers in Government—How Many, What Kind, What They Do[1]

Engineering Education and Its Relation to Government Service[1]

Special Citizenship Responsibilities of the Engineer[1]

9:30 a.m.

Hydraulic (I)

Pump Turbines

Design Features of Flatiron Power and Pumping Plant, by *John Parmakian,* Bureau of Reclamation (Paper No. 55—S-30)

Performance Characteristics of Francis-Type Pump Turbines[1]

9:30 a.m.

Machine Design (I)

A Method for the Selection of Valves and Power Pistons in Hydraulic Servos, by *F. C. Paddison* and *W. A. Good,* The Johns Hopkins University (Paper No. 55—S-10)

Contributions to Hydraulic Control 7 Analysis of the Effects of Nonlinearity in a Valve-Controlled Hydraulic Drive, by *E. I. Reeves,* Massachusetts Institute of Technology (Paper No. 55—S-9)

9:30 a.m.

Materials Handling (I)—Management (I)

Belt Conveyers for People[1]

Materials-Handling Engineering[1]

9:30 a.m.

Power (I)

Marine Practice

Torsional Vibration and Short Circuit of Marine-Geared Turbine-Generator Set[1]

Rotary Regenerative Heaters for Shipboard Installations, by *R. P. Giblon,* George G. Sharp, Inc.; *C. E. Hoch,* Military Sea Transportation Service; and *W. E. Hammond,* Air Preheater Corp. (Paper No. 55—S-32)

Comparison of Design and Service Performance of Some Modern Tankers[1]

[1] See box on page 279.

12:15 p.m.

President's Luncheon

Speaker: *David W. R. Morgan,* President and Fellow, ASME

2:30 p.m.

Aviation (II)

Zero Launching for Matador[1]

Jet-Aircraft Thrust Reversal[1]

Recent NACA Thrust Reversal Investigations[1]

2:30 p.m.

Hydraulic (II)—Applied Mechanics (I)

Hydraulic Research and Analysis

Water Tunnels for Hydraulic Investigations, by *J. M. Robertson,* University of Illinois (Paper No. 55—S-19)

An Extension of the Theory of Water Hammer, by *Richard Skalak,* Columbia University (Paper No. 55—S-18)

Design of Optimum Clearances in Positive Displacement Pumps and Motors, by *W. E. Wilson,* Pennsylvania State University (Paper No. 55—S-4)

2:30 p.m.

Machine Design (II)

Method of Filling Up a Reel at a Constant Rate of Feeding, by *Stephen Kulik,* University of South Carolina (Paper No. 55—S-12)

Surface Roughness and the Design Engineer, by *Joseph Manuele,* Westinghouse Electric Corp. (Paper No. 55—S-11)

2:30 p.m.

Materials Handling (II)—Management (II)

Pneumatic Conveying of Chemicals in Water Plants[1]

Management Aspects of Automation[1]

2:30 p.m.

Power (II)

Cooling-Water Treatment

Significance of Slime in Causing Corrosion and Mechanisms of Corrosion by Slime Growth[1]

The Treatment of Condenser Circulating Water[1]

Control of Slime and Marine Fouling[1]

2:30 p.m.

Production Engineering (I)

Production-Welding Principles[1]

New Applications for Welding[1]

8:00 p.m.

Junior

Speaker: *Samuel S. Baxter,* Commissioner, Department of Water, City of Philadelphia, Pa.

Speaker: *Henry A. Barnes,* Director of Traffic, City of Baltimore, Md.

Subject: **The Engineer as a Public Employee**

Guests of the Old Guard

Anthracite-Lehigh Valley, *J. W. Bowman*
Baltimore, *C. D. Alvey*
Buffalo, *T. W. Fitzgerald*
Central Pennsylvania, *J. D. Decker*
Delaware, *J. P. Folsom*
Philadelphia, *N. R. Deming*
Rochester, *P. D. Hansen*
Schenectady, *S. Weidler*
Southern Tier, *R. C. Reese*
Susquehanna, *L. P. Brown, Jr.*
Syracuse, *V. D. Schwartz, Jr.*
Washington, *R. R. Bouche*

8:00 p.m.

Aviation (III)

Air Mobility for Tactical Units[1]

Flow Control—The Integration of Power Plant and Airframe for Future Aircraft[1]

Some Design and Operational Problems Associated With Vertical Take-Off Weapons Systems[1]

TUESDAY, APRIL 19

8:00 a.m.

Registration

9:30 a.m.

Gas-Turbine Power

Evaluation of Marine Gas-Turbine Generator Sets[1]

The Development of a 500-Hp Multipurpose Gas-Turbine Engine[1]

Sulphur-Dewpoint Corrosion in Exhaust Gases[1]

9:30 a.m.

Management (III)

New Developments + Know-How = ?, by *J. W. Reid,* Design Engineering Corp. (Paper No. 55—S-13)

The Basic Theory of Managerial Control, by *J. V. McKenna,* Syracuse University (Paper No. 55—S-6)

Evaluating Intangibles for Executive Decisions, by *A. L. Stanly,* Hughes Aircraft Co. (Paper No. 55—S-28)

9:30 a.m.

Metal Processing

Heavy-Duty Machining[1]

9:30 a.m.

Power (III)

Steam-Power-Plant Practice

Design Features, Operating Experience, and Performance of 100,000-Kw Reheat Installation at Potomac River Station, by *L. W. Cadwallader,* Potomac Electric Power Co., and *H. S. Frederick,* Stone & Webster Engineering Corp. (Paper No. 55—S-21)

Regenerative Air Heaters for Application With Higher-Differential Pressures[1]

An Approach to the Economic Problem of Matching Condenser Surface With Exhaust Annulus Area, by *W. A. Wilson* and *L. G. Malouf,* Massachusetts Institute of Technology (Paper No. 55—S-31)

9:30 a.m.

Production Engineering (II)—Materials Handling (III)

Plant Layout in Assembly Plants[1]

Material Handling for Automotive Assembly[1]

12:15 p.m.

Management Luncheon

Presiding: *L. E. Newman,* Chairman, ASME Management Division; General Electric Co., New York, N. Y.

Speaker: *H. B. Maynard,* president, Methods Engineering Council, Pittsburgh, Pa.

Subject: **Extending Management Know-How Abroad**

2:30 p.m.

75th Anniversary Panel

The Engineer's Responsibilities in Government

6:30 p.m.

Banquet

WEDNESDAY, APRIL 20

8:00 a.m.

Registration

9:30 a.m.

75th Anniversary Panel

The Engineer and the Prospects for Peace

12:15 p.m.

American Rocket Society Luncheon

Toastmaster: *Richard W. Porter,* president, American Rocket Society

Speaker: *G. Edward Pendray,* Pendray & Co., New York, N. Y.

Subject: **Review of Twenty-Five Years' Progress in the American Rocket Society**

2:30 p.m.

American Rocket Society (I)

Rocket-Test Vehicles

The Use of Rocket Vehicles for Upper Atmosphere Research, by *J. W. Townsend, Jr.,* Naval Research Laboratory

Flight Measurements of Aerodynamic Heating and Boundary-Layer Transition on the Viking 10 Nose Cone, by *R. B. Snodgrass,* Naval Research Laboratory

Sunfollower for Upper Atmosphere Research, by *G. J. Granros,* Aircraft Armaments, Inc.

The Worthwhileness and Applications of a Minimum Orbital Unmanned Satellite of the Earth (MOUSE), by *S. F. Singer,* University of Maryland

2:30 p.m.

Instruments and Regulators—Aviation (IV)

Aircraft Instrumentation

Symmetrical Aircraft-Gyroscope Motor for Optimum Performance, by *H. C. Wendt,* General Electric Co., West Lynn, Mass. (Paper No. 55—S-26)

Fundamentals of the Vibratory-Rate Gyro, by *J. B. Chatterton,* Sperry Gyroscope Co. (Paper No. 55—S-25)

The General Mills Ryan Flight Recorder, by *J. J. Ryan,* General Mills, Inc., and University of Minnesota (Paper No. 55—S-27)

2:30 p.m.

Metals Engineering (I)

Testing of Small-Diameter Tubing With Automatic Recording Ultrasonic Equipment, by *W. L. Fleischmann* and *H. A. F. Rocha,* General Electric Co. (Paper No. 55—S-23)

The Use of Ultrasonic-Attenuation Measurements for the Study of Engineering Properties of Materials, by *Rohn Truell,* Brown University (Paper No. 55—S-17)

Use of Data Obtained from Sonic Testing of Plain Concrete, by *C. E. Kesler* and *T. S. Chang,* University of Illinois (Paper No. 55—S-3)

Preprint Orders

Only preprints of *numbered* ASME papers will be available. Some of these papers may not be available in time to permit your receiving them in advance of the meeting. Your order will be mailed only when the complete order can be filled unless you request that all papers available ten days before the meeting be mailed at that time. Please order only by paper *number;* otherwise the order will be returned. The final listing of available technical papers will be found in the issue of Mechanical Engineering containing an account of the meeting.

Preprints of ASME papers may be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members, 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons, in lots of ten, are $2 for members; $4 for nonmembers.

Preprints of unnumbered papers listed by title only in the tentative program *are not available* because the review of these manuscripts had not been completed when the program went to press. The author's name and preprint number will appear with the paper title in the final program (final program available only at meeting) as well as the issue of Mechanical Engineering containing an account of the meeting, if the paper is recommended for preprinting.

2:30 p.m.

Power (IV)—Nuclear Energy (I)

Nuclear Power

Shielding Concepts for Nuclear Reactors, by H. E. Stone, General Electric Co. (Paper No. 55—S-20)

The Use of Benzene as a Thermodynamic Working Fluid for a Nuclear-Power Plant, by *R. H. Shannon,* Atomic Power Development Associates, and *I. G. McChesney,* Rochester Gas & Electric Corp. (Paper No. 55—S-29)

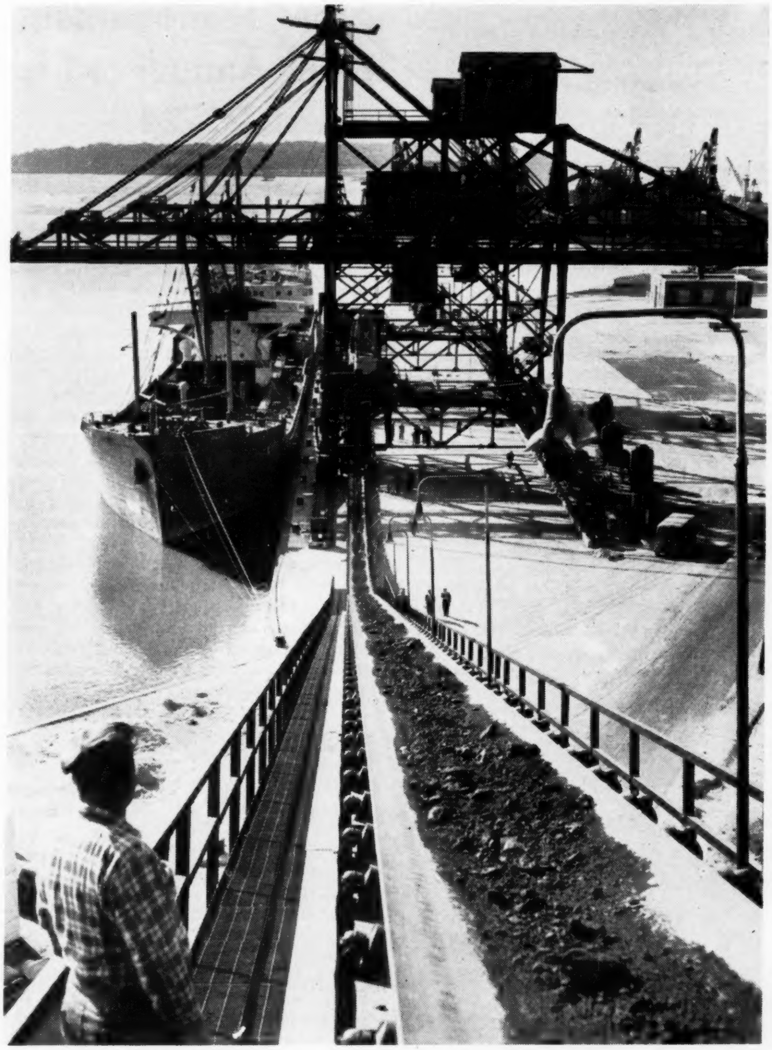
The Homogeneous Reactor Experiment—A Pilot-Model Nuclear-Power Plant, by *W. R. Gall,* Oak Ridge National Laboratory (Paper No. 55—S-15)

Equipment for Handling of Expended Reactor Fuels[1]

[1] See box on this page.

Free Coupons

The attention of ASME members is directed to the expiration dates of free coupons which may be exchanged for technical papers. The final date on which a free coupon is valid is noted on each coupon. Please examine free coupons before mailing, since the Society cannot honor free coupons which have expired.



B&O RR $5-million pier at Curtis Bay, Baltimore Harbor, to handle imported ores will be visited during the ASME Diamond Jubilee Spring Meeting, April 18–22. The pier is the first completely new facility of its type especially designed to handle the increasing flow of foreign ores to the United States. The 650-ft pier has two unloading towers. Each tower has a 15-ton bucket, one of which can be seen in the center of the picture. The two unloading machines have a combined sustained capacity of 2000 tons per hr. Thus a 12,000-ton ship like the one pictured can be unloaded in six hours. The SS *Chilore,* of the Ore Steamship Company, a subsidiary of the Bethlehem Steel Company, brought in a load of Chilean iron ore for the opening-day ceremonies, May 15, 1954.

Registration Schedule

Sunday, April 17, 3:00 p.m.–5:00 p.m.
Monday, April 18, 8:00 a.m.–8:00 p.m.
Tuesday, April 19, 8:00 a.m.–5:00 p.m.
Wednesday, April 20, 8:00 a.m.–5:00 p.m.
Thursday, April 21, 8:00 a.m.–3:00 p.m.

THURSDAY, APRIL 21

8:00 a.m.

Registration

9:30 a.m.

American Rocket Society (II)

Instrumentation in the Rocket Field

Photography From the Viking 11, by *Leopold Winkler*, Naval Research Laboratory

Instrumentation Techniques and Requirements for Rocket and Guided-Missile Testing, by *H. B. Riblet*, The Johns Hopkins University

Practical Factors in Rocket Telemetering, by *D. G. Mazur*, Naval Research Laboratory

Pressure Measurement at Audio Frequency, by *H. B. Jones, Jr.*, instrumentation engineer, Short Hills, N. J.

9:30 a.m.

Metals Engineering (II)—
Nuclear Energy (II)—
Power (V)

Evaluation of Basic Materials for Nuclear-Fueled Power Plants, by *D. O. Leeser*, The Detroit Edison Co. (Paper No. 55—S-14)

Zirconium—Fabrication Techniques and Alloy Development[1]

Selection of Materials for a Sodium-Graphite Reactor System, by *C. C. Woolsey*, North American Aviation, Inc. (Paper No. 55—S-16)

The Role of Powder Metallurgy in the Design of Nuclear-Power Reactors, by *H. H. Hausner* and *M. C. Kells*, Sylvania Electric Products Inc. (Paper No. 55—S-24)

9:30 a.m.

Process Industries (I)

Is Chemistry in the Power Plant an Exact Science?[1]

9:30 a.m.

Safety

Facts on Auto-Crash Survival

The Study of Automobile Doors Opening Under Impact Conditions[1]

Application of Quality-Control Techniques to Accident Data[1]

2:30 p.m.

American Rocket Society (III)

Manned-Rocket Vehicles

Rotor-Rocket Development for Helicopters, by *W. R. Brown*, Reaction Motors, Inc.

Some Practical Aspects of Rocket-Powered Aircraft, by *W. F. Moore* and *R. C. Smith*, Bell Aircraft Corp.

Systems Engineering for Human-Flight Control, by *L. J. Fogel*, Stavid Engineering, Inc.

Future Applications for Manned-Rocket Vehicles, by *C. L. Forrest* and *R. B. Crisman*, Bell Aircraft Corp.

2:30 p.m.

Applied Mechanics (II)

Elasticity and Vibrations

Bending of Pretwisted Beams, *J. Zickel*, General Electric Co. (Paper No. 55—S-2)

Stress Distributions in Orthotropic Strips, by *H. D. Conway*, Cornell University (Paper No. 55—S-1)

Vibrations of a Helicopter Rotor-Fuselage System Induced by the Rotor Blades in Flight, by *M. Morduchow, S. W. Yuan,* and *H. Reissner*, Polytechnic Institute of Brooklyn (Paper No. 55—S-7)

Matrix Analysis of Piping Flexibility, by *J. E. Brock*, U. S. Naval Postgraduate School (Paper No. 55—S-5)

2:30 p.m.

Fuels—Process Industries (II)

Specialized Uses of Gas as Fuel

Generation and Use of Sewage Gas in Municipal Sanitation[1]

Radiant Panels for Tin Reflow, by *G. J. Campbell*, Bethlehem Steel Co. (Paper No. 55—S-22)

2:30 p.m.

Metals Engineering (III)—
Machine Design (III)

Powder Metallurgy

Powder-Metal Materials Applied to Mechanical Parts[1]

An Evaluation of Brass-Powder Structural Parts in Product Engineering[1]

[1] See box on page 279.

ASME Management Division Conference Plans Announced for Cleveland, Ohio, March 23-24

"Bigger, Better, and More," Theme Sparks Management Conference Plans

The Annual Conference of the Management Division of The American Society of Mechanical Engineers will be held at the Hotel Statler, Cleveland, Ohio, March 23–24, 1955. This event is planned as a management conference for engineers.

Elaborating on the theme, Bigger, Better, and More, the program of timely topics will be presented by people of successful experience—some engineers, some not—but all able managers. The speakers will discuss how to get "more engineering at less cost." Their papers will concentrate on solutions to the problems of engineering administration and will be aimed at helping to produce more for the engineering dollar. The present-day shortage of qualified engineering talent, the cost of engineering, and the need for faster and more complete engineering should make this conference unusually attractive to engineers who want to progress as engineering executives.

Bigger, Better, and More

Our great American economy is predicated on an insatiable desire for "more." Business and industry are devoted to meeting this want by providing goods and services that, year by year, are bigger, better, and available to more people more often. Engineers, as a group, have played a vital and dynamic part in this progress. They have received world-wide recognition for their technical proficiency, their creative talents, and their unique facility for doing the seemingly impossible. And this praise has been highlighted to the point where they are considered by some to be "terrific as technicians" and "terrible as administrators."

Are Engineers Executives?

The question as to whether or not engineers as a group are poor executives, inexperienced in the art of managing and administering, is one that could be debated—but to what avail? Possibly one could change the thinking of our nation and world by debate. A much more effective way is to set out to do something about this apparently underdeveloped skill. We know from our engineering experiences that whatever we are doing can be improved—and can be improved far beyond our immediate expectations. To do this, however, we must first recognize the need. There is a real need for better management. Then, it is our job to direct our attention toward fulfilling this need.

Developing Managerial Skills

The development of managerial skills in engineers requires that engineers, both individually and collectively, apply their thinking and their energies to the problems of management. This means study, hard work, practice, and a constructive exchange of ideas and experiences. The ASME Management Division is organized to help in "building better engineering executives." One important part of the Management Division program, pointed toward the exchange of know-how, is the Annual Management Conference.

Approximately 25 per cent of the ASME membership is enrolled in the Management Division. This evidence highlights the interest of engineers in management subjects and activities. When 25 per cent of a group have a single preference it follows that the thinking of the entire group can be influenced greatly, provided a constructive course of action is planned and then carefully executed. The Management Division is working toward building better engineering executives. The technical program for the Management Conference in Cleveland is designed to be an important step toward achieving that objective.

Technical Program

An outline of the program follows. Look it over and then register early.

WEDNESDAY, MARCH 23

9:30 a.m. Euclid Ballroom

Session I—Selection and Training

Chairman: *Sam Littlejohn,* commercial vice-president, General Electric Co.

Vice-Chairman: *Colin Carmichael,* editor, *Machine Design,* Penton Publishing Co.

Co-Operative Training, by *C. F. Roby,* vice-president, The Cincinnati Milling Machine Co. (Paper No. 55—MGT-3)

Recruiting and Training Engineering Graduates for Industry, by *R. E. Sprenkle,* director of education, Bailey Meter Co. (Paper No. 55-MGT-7)

Progressive Management and the Engineer, by *J. H. Elkus,* manager—factory service, Blaw-Knox Co., Pittsburgh, Pa. (Paper No. 55—MGT-2)

12:15 p.m. Grand Ballroom

Luncheon

Presiding: *L. E. Newman,* chairman, ASME Management Division; manager, health and safety services department, General Electric Co.

Speaker: *C. R. Sutherland,* Reliance Electric and Engineering Co.

Subject: **Planning Tomorrow's Engineering Budget**

2:30 p.m. Euclid Ballroom

Session II—Better Methods

Chairman: *F. W. Hornbruch, Jr.,* chief engineer, Rath & Strong, Inc.

Vice-Chairman: *Edwin Crankshaw,* chief engineer, Cleveland Graphite Bronze Co.

Streamlining Drafting Operations, by *A. H. Rau,* consultant-drafting, General Electric Co. (Paper No. 55—MGT-6)

Rigidity—The Unknown Cost-Reduction Factor, by *C. A. Bierlein,* director of inspection and test, Cleveland Diesel Engine Division, General Motors Corp. (Paper No. 55—MGT-1)

Get More Mileage From Your Engineers, by *Guy Kleis,* manager, central technical departments, Westinghouse Electric Corp.

5:30 p.m. Parlors, 1, 2, 3

Reception

6:30 p.m. Grand Ballroom

Banquet

Presiding: *C. E. Richards,* chairman, ASME Cleveland Section; manager, production engineering, Cleveland Electric Illuminating Co.

Toastmaster: *Thompson Chandler,* Vice-President, ASME Region V; head, Engineering Service Division, research and development department, Carbide and Carbon Chemical Co. Div., Union Carbide and Carbon Corp.

Speaker: *David W. R. Morgan,* President, ASME; vice-president, Westinghouse Electric Corp.

Subject: **We Need Better Engineering**

THURSDAY, MARCH 24

9:30 a.m. Euclid Ballroom

Session III—Standardization

Chairman: *G. T. Trundle,* president, Trundle Engineering Co.

Vice-Chairman: *R. C. Sessions,* assistant to the director, National Advisory Committee for Aeronautics

Standard Parts, by *Cyril Ainsworth,* technical director and assistant secretary, American Standards Association, Inc.

Better Jigs and Fixtures at Less Cost, by *M. J. Look,* process engineer, The Singer Manufacturing Co. (Paper No. 55—MGT-5)

Persuading People—Events Leading to the Experience of Change Within an Organization, by *J. H. Roach,* vice-president, Penn Brass and Copper Co.

12:15 p.m. Ohio Room

Luncheon

Presiding: *M. B. Robinson,* dean of personnel service, Fenn College

Speaker: *G. B. Earnest,* president, Fenn College

Subject: **The Professional Status—Unionization Problem**

2:30 p.m. Euclid Ballroom

Session IV—Administration

Chairman: *C. A. Butler, Jr.,* director of commercial development, Diamond Alkali Co.

Vice-Chairman: *M. B. Sampson,* chief engineer, S. P. Manufacturing Corp.

Incentives, by *V. M. Gelin,* manager, methods and standards, pigments department, E. I. du Pont de Nemours and Co., Wilmington, Del.

Engineers in Your Organization, by *F. F. Bradshaw,* president, Richardson, Bellows, Henry and Co.

Human Relations in Industry, by *Lydia Giberson,* MD, personal adviser, Metropolitan Life Insurance Co. (Paper No. 55—MGT-4)

ASME-AIChE Joint Symposium on Heat Transfer, March 21-22

The Heat Transfer Division of The American Society of Mechanical Engineers has joined with the American Institute of Chemical Engineers to present a symposium on heat transfer, March 21–22. The symposium consisting of 18 papers will be given in three sessions during the AIChE spring meeting to be held in the Kentucky Hotel, Louisville, Ky. The papers have been preprinted by AIChE.

Much work has gone into the preparation of this joint technical meeting. Plans also include several interesting plant-inspection trips and a well-arranged program for the women.

The program follows:

MONDAY, MARCH 21

9:00 a.m.

Presiding: *S. W. Churchill* (Technical Session No. 2)

The Concentration of GR-S Latex in a Turbulent Film Evaporator, by *E. L. Borg, R. L. Provost,* and *C. V. Bawn,* Naugatuck Chemical Division, U. S. Rubber Co.

Heat Transfer for Vaporization of Water in a Vertical Tube, by *C. E. Dengler* and *J. N. Addoms,* Massachusetts Institute of Technology

A Study of Heat Transfer to Organic Liquids in Single-Tube Natural-Circulation Vertical-Tube Boilers, by *S. A. Guerrieri* and *R. Talty,* University of Delaware

Circulation Rates and Over-All Temperature Driving Forces in a Vertical Thermosyphon Reboiler, by *A. I. Johnson,* du Pont Company of Canada, Ltd.

Pressure Drop During Forced-Circulation Boiling, by *G. Leppert,* Stanford University; *M. Jakob,* Illinois Institute of Technology; and *J. B. Reynolds,* Dow Chemical Co.

Effect of Air Rate, Water Rate, Temperature, and Packing Density on a Crossflow Cooling Tower, by *N. W. Snyder,* University of California

2:00 p.m.

Presiding: *A. C. Muller* (Technical Session No. 4)

Measurement and Prediction of Density Transients in a Volume-Heated Boiling System, by *R. P. Lipkis, G. Liu,* and *N. Zuber,* University of California

Prediction of Heat-Transfer Burnout, by *L. Bernath,* E. I. du Pont de Nemours & Co., Inc.

Correlation of Maximum-Heat Flux Data for Boiling Liquids, by *W. Rohsenow* and *P. Griffith,* Massachusetts Institute of Technology

Effect of Agitation at the Critical Temperature Difference for a Boiling Liquid, by *F. S. Pramuk* and *J. M. Westwater,* University of Illinois

Heat Transfer in the Condensation of Metal Vapors, Mercury, and Sodium up to Atmospheric Pressure, by *C. F. Bonilla* and *B. Misra,* Columbia University

Heat and Mass Transfer During Cooling and Condensation of Saturated Titanium Tetrachloride-Nitrogen Mixtures, by *R. W. Schuler* and *J. B. Abell,* Research and Engineering Divisions, Monsanto Chemical Co.

Simultaneous Heat and Mass Transfer in Partial Condensation, by *E. Kent* and *R. L. Pigford,* University of Delaware

TUESDAY, MARCH 22

9:00 a.m.

Presiding: *O. P. Bergelin* (Technical Session No. 6)

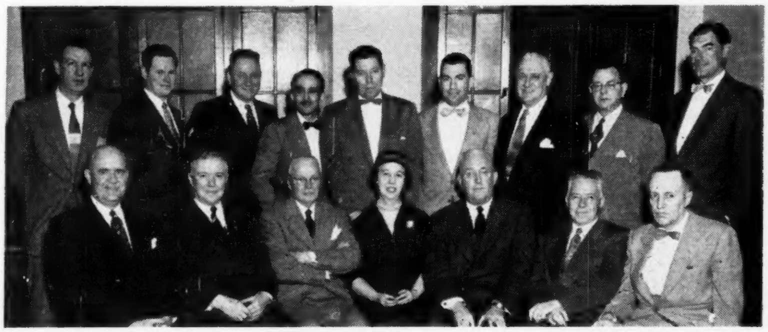
Properties of Evaporated Metal Films Related to Their Use for Surface-Temperature Measurement, by *T. B. Simson* and *C. C. Winding,* Cornell University

Distribution of Temperature in 1-2-Pass Heat Exchangers With Shell-Side Fluid Changes in Phase and Temperature, by *H. T. Bates,* University of Nebraska

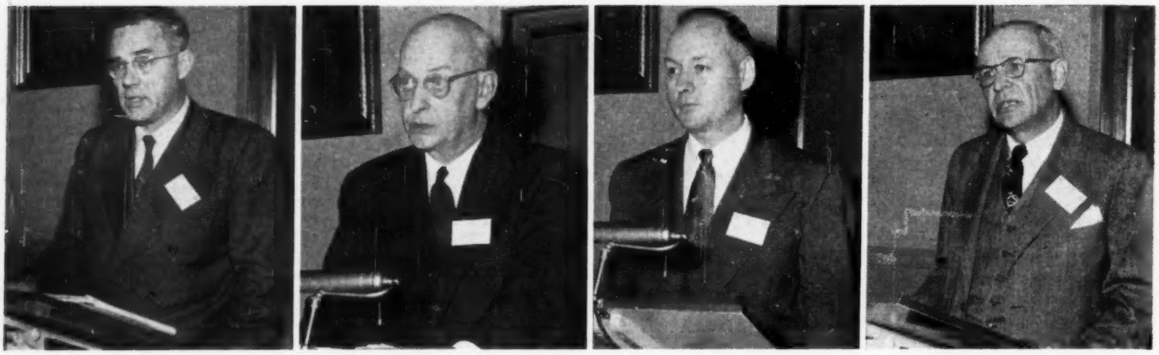
Recorrelation of Data for Convective Heat Transfer Between Gases and Single Cylinders With Large Temperature Differences, by *W. J. M. Douglas* and *S. W. Churchill,* University of Michigan

Effect of Void Volume and Prandtl Modulus on Heat Transfer in Tube Banks and Beds, by *Joel Weisman,* Brookhaven National Laboratory

Heat Transfer and Fluid Friction in a Shell and Tube Exchanger With a Single Baffle, by *F. W. Sullivan* and *O. P. Bergelin,* University of Delaware



Preparations for the ASME Diamond Jubilee Annual Meeting, to be held in Chicago, Ill., Nov. 13–18, were reported at a dinner meeting held recently in the host city, with more than 80 in attendance. Indications that this is to be the biggest and best meeting yet are disclosed by the progress reports of the chairmen or their representatives seated, *left to right,* C. W. Parsons, secretary, *Executive Committee;* W. A. Dundas, *Annual Banquet;* J. D. Cunningham, past-president, ASME, and co-chairman, *Executive Committee;* Mrs. Alexander Gowie, *Ladies' Committee;* R. H. Bacon, chairman, *General Arrangements;* F. J. Hamilton, *Reception;* and E. C. Bailey, *Liaison With Chicago Section.* Standing, *left to right,* E. F. Obert, vice-chairman, *Technical Program;* A. J. Snider, *Hotel;* R. A. Budenholzer, *American Power Conference;* Paul Berndt, *Commemoration;* John Dolio, *Publicity;* W. H. Pletta, *Plant Inspection;* A. B. Openshaw, *Entertainment and Hospitality;* T. N. Gluck, vice-chairman, *Registration, Information, and Tickets;* and E. P. Berg, *Finance.*



Technology Executives Conference at Gulf Research Laboratories, Harmarville, Pa., Jan. 13–14, discussed the problems of the ASME Board on Technology Professional Divisions Committees. Reports were given by Professional Divisions leaders, some of whom are shown, *left to right,* R. G. Folsom, member, Professional Divisions Committee; R. C. Allen, chairman, ASME Main Research Committee; D. H. Cornell, member, Professional Committee; and Otto de Lorenzi, chairman, ASME Publications Committee.

ASME Technology Executives Conference Discusses Problems of Meetings, Professional Divisions, Publications, and Research Committees

Upward of 50 ASME Committee members attended a two-day Technology Executives Conference at the Gulf Research Laboratories, Harmarville, Pa., Jan. 13 and 14, 1955, for the purpose of discussing problems relating to the Board on Technology and the Professional Divisions, Meetings, Publications, and Research Committees.

The Conference was an expansion of the one held by the Professional Divisions Committee at the Knolls Laboratory of the General Electric Company, Schenectady, N. Y., in February, 1954. (See Mechanical Engineering, March, 1954, pp. 298–300.)

Gulf Research Laboratories Hosts of Conference

As hosts of the Conference, the Gulf Research and Development Company provided registration and social facilities at the William Penn Hotel for members who arrived on Wednesday and buses to and from the laboratories on Thursday and Friday. Approximately 18 members of the Laboratories staff were on hand to handle the innumerable details of the Conference and serve the needs of individuals. At the Laboratories provision was made for coffee breaks and luncheons at the cafeteria, and a two-hour inspection tour of the buildings and research projects at Harmarville on Thursday afternoon.

On Thursday evening the hosts met with the visiting ASME members for a cocktail hour and dinner at the University Club. At the dinner, at which about 30 Gulf engineers were also present, E. W. Jacobson presided. He paid personal tribute to T. R. Olive, who had served as chairman of the Board on Technology in 1954 when the idea of the Conference was conceived and put into action, and to T. F. Perkinson who had conducted the 1954 Conference at the Knolls Laboratory. He introduced J. Edward Taylor, head of the Automotive Division, Gulf Research and Development Laboratories, who gave an illustrated and informative talk entitled, "A Quick Look at New Gasolines and Oils."

E. W. Jacobson Opens Conference

E. W. Jacobson, chairman, ASME Professional Divisions Committee, served as general chairman of the Conference; R. B. Smith, chairman, ASME Board on Technology, as co-chairman; and J. M. Clark, ASME Divisions Manager, as secretary of the Conference.

In opening the Conference on Thursday morning, Mr. Jacobson referred to the 1954 Conference and to the decision to enlarge the scope of the 1955 Conference by including the Board on Technology and the standing committees operating under the Board. He called attention to the presence at the Conference of D. W. R. Morgan, ASME President; Thompson Chandler, vice-president, Region V; and S. G. Eskin, of the ASME 1955 Nominating Committee.

B. B. Wescott, director, Gulf Laboratories, Mem. ASME, delivered a friendly address of welcome in which he described briefly the organization of the Gulf Laboratories and the activities carried on by its numerous divisions which employ about 1250 persons.

President Morgan responded to the address of welcome with an expression of appreciation of the Society of the courtesies extended by the Laboratories.

Mr. Smith spoke of the basic responsibility of the Society in the creation and dissemination of engineering information, and reminded his audience that they and the committees they represented were responsible for the policies and mechanisms by means of which the society discharged its functions in these fields. He posed two general questions to be answered in a re-examination and reappraisal of Society publications:

1 Are we meeting the requirements of Society members?

2 Are we dynamic, progressive, and aggressive in meeting the responsibilities of the Board on Technology and the Committees reporting to that Board?

There had always existed some difficulty in understanding the functions of the Board, he said, because of their twofold nature—staff and line functions. The Board had taken the position that it should discharge the staff functions and the committees, the line responsibilities.

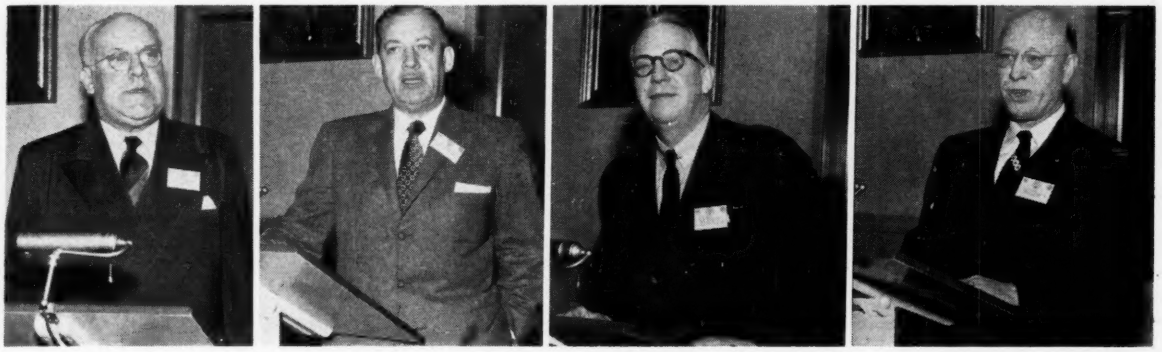
ASME Members Survey Questionnaire

O. B. Schier, 2nd, assistant secretary ASME, distributed copies of the initial report of the ASME Members Survey Questionnaire with tabulations of the responses to it. Of the 36,741 members who received the questionnaire last summer, 56 per cent or 20,575 had replied. A few high lights of the replies were emphasized by Mr. Schier, and it was announced that C. B. Peck, chairman of the Survey Committee, was planning to prepare two articles for Mechanical Engineering, one to cover the over-all results and the other to be based on correlations between certain categories of replies with others, where age, specialized interests of individuals, and similar relationships might have considerable significance.

At the question period which followed, a number of correlations not yet considered by the Survey Committee were offered.

ASME Publications

In opening the two-hour discussion on Society publications, R. G. Folsom, member, Professional Divisions Committee, said that the present publications policy had been the result of years of development in which many ideas had been advanced from time to time. Publications were important, he asserted, because one of the objectives of the Society was the dissemination of technical information. Publications served the objectives in two ways:



Among the leaders who addressed the Technology Executives Conference are, *left to right,* P. R. Sidler, member, Professional Divisions Committee; R. W. Flynn, chairman, ASME Meetings Committee; R. B. Smith, chairman, ASME Board on Technology and chairman of the Board's Nominating Conference; and B. B. Wescott, director, Gulf Research Laboratories, who welcomed the conferees to Gulf Research and Development Company Laboratories, hosts to the meeting

(*a*) They provided a record of the contributions made by members for the benefit of fellow members, and (*b*) they provided a service to the engineering profession and to the nation.

Seven topics relating to publications, placed on the program for discussion, were then outlined by Professor Folsom:

1 What is the present publications policy?
2 What can be done about publication of more Division papers?
3 Is preprinting equivalent to publication?
4 How to select papers for Transactions.
5 Experience with individual Division publications.
6 Comparison with publications policies of other societies.
7 Budgeted funds for publications.

Otto de Lorenzi, chairman, ASME Publications Committee, and George A. Stetson, editor of the Society, discussed the seven items in brief and generalized terms. It was pointed out:

1 That the present policy, adopted in January, 1948, aims to give maximum publications service with minimum expense and waste. However, owing to increased load of papers recommended for publication in full and increased cost of all printing items, the net cost of Transactions is today higher than ever before, in spite of the greatly reduced number of copies printed as a result of abandonment of free distribution in favor of subscriptions at nominal rates.

2 That more Division papers would increase cost to the Society; however, some divisions issue proceedings of their conferences as independent publications priced to recover a considerable portion of the manufacturing expense.

3 That ASME preprints constitute publication in a legal sense, but in many cases are not considered by authors and others to be satisfactory means of publication because of their impermanent form and because they afford no opportunity for thorough editing or for printed discussion.

4 That papers are selected for Transactions on the basis of the recommendations of the contributing divisions and committees by the Editor on authority delegated to him by the Publications Committee. Other alternative methods were suggested, including an advisory review committee of the Publications Committee.

5 That several divisions use a number of schemes for publishing papers not selected for Transactions, such as proceedings of Division Conferences.

6 That the practices of other engineering and scientific societies differ materially from those followed by ASME but the problems of publication are common to all societies and are frequently modified because of rising costs and the criticism of members.

7 That the budgeted funds for ASME periodical publications were reported in the January, 1955, issue of MECHANICAL ENGINEERING, although not in sufficient detail to show all of the breakdowns of income and expense that an individual member might wish to know. Net Transactions expense was $50,509.38 in 1943-1944. By placing Transactions on a subscription basis in 1948 this figure had been reduced to $32,205.56 in 1948-1949; but rising costs and volume of material printed had increased this net expense to $84,972.14 in 1953-1954. Efforts to reduce this net expenditure were being sought by the Council and the Publications Committee.

It was announced that the Publications Committee had set up a special advisory committee to study the many problems relating to publications and to make recommendations for the consideration of the Board on Technology. The views and suggestions of all interested persons were solicited; and in the general discussion that followed, many ideas, comments, and criticisms were put forward.

Six Topics Discussed on Friday

The program on Friday was devoted to the discussion of six topics:

1 National Meetings and Division Conferences, led by J. C. Peters, member, ASME Professional Divisions Committee;
2 Professional Divisions budget and custodian funds, led by Paul R. Sidler, member, ASME Professional Divisions Committee;
3 Distribution of income and expense in connection with national meetings of the Society, led by O. B. Schier, 2nd;
4 Section-Division co-operation led by D. H. Cornell, member, ASME Professional Divisions Committee;
5 Research projects, led by R. C. Allen, Allis-Chalmers Manufacturing Company, chairman, ASME Main Research Committee; and
6 Nominating procedure, led by R. B. Smith, chairman, ASME Board on Technology.

National Meetings and Division Conferences

Mr. Peters said that it was the aim of the Society to provide meetings and publications of ever-increasing quality. He called upon R. W. Flynn, chairman, ASME Meetings Committee who said that the original ASME charter objective emphasized the dissemination of information. It was Society policy, he said, not to publish papers before they had been presented and to emphasize quality rather than quantity in meetings and papers. The report of the Board on Technology, accepted by the Council at the 1953 Semi-Annual Meeting as a desirable objective, had contained an outline of procedures for the improvement of meetings and publications and stressed the importance of the selection of able chairmen to conduct technical sessions at meetings. He urged all persons concerned to think carefully about National Meetings and Division Conferences and to analyze attendance statistics as a means toward planning for better meetings.

Mr. Peters explained that planning a Division Conference was about the same as planning a National Meeting except for the fact that the Division had greater responsibility in the Conference and assumed many tasks performed by the Secretary's Office in the case of National Meetings. He explained the relationship of the Division and the host Section in the case of a Conference and emphasized several points upon which the successful operation of a Conference would depend. He then called for brief reports of the experiences of certain Divisions in conducting Conferences: M. A. Scheil, secretary, ASME Petroleum Division; John A. Worthington, ASME Oil and Gas Power Division; W. E.

Left photo, **J. Edward Taylor, *left,* director, Automotive Engineering Division, Gulf Laboratories, being congratulated on his informative talk on new gasolines and oils before the Technology Executives Conference dinner by O. B. Schier, 2nd, *center,* assistant secretary ASME, and R. B. Smith, *right,* chairman, ASME Board on Technology. *Right photo,* B. B. Wescott, *left,* director, Gulf Laboratories, pauses to chat with David W. R. Morgan, *center,* ASME President, and E. W. Jacobson, chairman, ASME Professional Divisions Committee, who presided over the Technology Executives Conference. Mr. Jacobson is chief design engineer at Gulf Research and Development Company.**

Belcher, Jr., ASME Instruments and Regulators Division; J. P. Critchlow, ASME Lubrication Activity; H. N. Muller, Jr., ASME Management Division; and N. J. Hoff, chairman, ASME Applied Mechanics Division.

Professional Divisions Budget and Custodian Funds

Mr. Sidler reminded members present that each standing committee operating under the Board on Technology had its own budget. These committees operated as a team and a fair allocation of Society funds to each committee was necessary and desirable. As to the Professional Divisions budget, he pointed out that needs and estimates of expenses had to be made 18 months in advance. Expense items to be considered fell into three groups, he said, normal recurring items, such as stationary; extraordinary and nonrecurring items, such as promotional material and travel; and Conference items. Division Conferences were increasing in number, he stated, there being 13 planned for the present calendar year. Divisions should plan conferences at least two years in advance. Under a policy adopted by the Council, he said, about eight Divisions had established custodian funds. These funds have been accumulated by the Divisions and are carried on the Society's books. They are used by the Divisions for certain expenses and projects of their own.

Distribution of Income and Expense

Mr. Schier described a document, "Policy Governing Distribution of Income and Expense for National Meetings and Division Conferences," which he had prepared and which is subject to formal approval. This document lists the major categories of expense for both types of meetings and describes clearly what expenses are charged against the Meetings and Professional Divisons budgets, what expenses should not be incurred by the host Section, and other matters relating to local solicitation of funds, nonmember registration fees, preprints of papers, and exhibitions. Comments and criticisms on the document, copies of which were distributed at the Conference, were solicited.

Sections-Divisions Co-operation

Mr. Cornell introduced the subject of Sections-Divisions Co-operation and called on Sergei Guins, member of the Sections-Divisions Co-operation Committee, to tell the members of the Conference what some of the Sections were doing to develop closer co-operation. He said that while some of the larger Sections held Division meetings at the local level, many of the smaller Sections could not do so and had developed discussion groups to meet the needs of their members who had interests in certain specialized areas. Some of these discussion groups had been described in Mechanical Engineering. The section of the Sections Manual on discussion groups had been rewritten. In the coming year he expected to tackle the subject from the Professional Divisions' point of view.

Mr. Chandler discussed the subject at length and dwelt particularly on the Region V plan for regional meetings which was presented at the 1954 Regional Delegates Conference. He said that there was a growing interest in the Professional Divisions approach among the Sections and that Region V included eight Sections in which discussion groups are in operation. He expected further discussion of the subject by the Vice-Presidents at their February, 1955, meeting.

Philip Freneau, chairman, Sections-Divisions Co-operation Committee, Region V, asked how many members of the Conference were active in the affairs of their Sections. A show of hands indicated about 30 per cent. Mr. Freneau then commented that too many members considered themselves either Sections or Professional Divisions men. A lively discussion of the subject developed.

Research Projects

Mr. Allen read from a manuscript describing the ASME Research Committee, its organiza-

Technology executives who attended the Conference were taken on an inspection trip around Gulf Laboratories. They are shown viewing the Gulf capacitance product analyzer. They also visited the machine-shop model room, entomology laboratory, and the electrical oil-reservoir analyzer.

tion, and its special research committees, and told about a number of ASME research activities that had been successfully carried on in the past as well as those that are currently active. F. S. Mallette, ASME Research Manager, supplemented Mr. Allen's presentation, and described the Society's fund-raising activities and the sources of funds raised for specific research projects. Although some appropriations were made by The Engineering Foundation for ASME research projects, the Foundation's funds were limited, and from 70 to 99 per cent of the money spent by the Society on research was now being contributed by industry.

Nominating Conference

Mr. Smith explained that changes in the organization of the ASME Council and Nominating Committee recently adopted made it necessary for the Board on Technology to conduct a nominating conference of representatives of the Committees (Meetings, Professional, Divisions, Publications, and Research) that operate under the Board. This conference had been called to meet at the time of the Technology Executives Conference at Harmarville. Mr. Smith and the representatives of the four committees then retired for a brief executive session and later announced that this meeting had been adjourned until April 1. Before that date, he said members or committees should send to him names of candidates for the office of director, one to serve for one year and another to serve four years. Names submitted to the Board on Technology Nominating Conference will be passed on to the 1955 ASME Nominating Committee which will meet at the time of the 1955 Diamond Jubilee Semi-Annual Meeting to be held in Boston, Mass., June 19 to 23.

ASME IRD Automatic-Control Conference Planned for April 25-26

The campus of the University of Michigan in Ann Arbor will be the scene of a two-day conference on automatic control, sponsored by the Instruments and Regulators Division of The American Society of Mechanical Engineers. Conference Chairman John Hrones of M.I.T., in co-operation with the Detroit Section of ASME and the engineering faculty of the University of Michigan, has lined up an outstanding series of papers centered around the control of physical systems, physical systems with a human operator, and business and economic systems. Emphasis will be placed on the basic dynamics of control rather than upon mathematical methods of solution. Specific papers will deal with: The steps needed to establish, in specific terms, the fundamental relationships describing the system under consideration; the validity of assumptions made; the character of tests made to determine essential information; the determination of the actual value or range of values of the quantities used; and the direct application of results to analogous systems.

ASME Machine Design Division Conference at NYU, April 6

The Machine Design Division of The American Society of Mechanical Engineers will hold its 1955 Conference in Gould Student Center of the New York University, University Heights, New York, N. Y., April 6.

The one-day Divisional Conference is being held at the invitation of the Metropolitan Section of the Society as a part of the celebration of the Centennial of NYU's College of Engineering.

The papers will develop production considerations in machine design. As the industrial market is becoming more competitive, the designer must pay increased attention to the reduction of production costs without a sacrifice in the quality of the product.

The technical program follows:

WEDNESDAY, APRIL 6

9:00 a.m. **Auditorium**

Morning Session

Chairman: *G. F. Habach,* executive engineer, Worthington Corp., Harrison, N. J.

Vice-Chairman: *M. G. Fangemann,* general manager, Spring Division, John Chatillon & Sons, New York, N. Y.

Panel discussion of the following papers:

Production Considerations in Machine Design, by *W. C. Allen,* Westinghouse Electric Corp., Pittsburgh, Pa.

Designing for Production—Its Importance, Its Problems, and Suggested Solutions, by *J. H. Conard,* Chandler-Evans Division, Niles Bement-Pont Co., West Hartford, Conn.

Production Consideration in Machine Design With Particular Reference to Such Products as Ball Bearings, by *Henry Michelsen,* General Motors Corp., Bristol, Conn.

Production Considerations in Design, by *W. C. Cadwell,* Caterpillar Tractor Co., Peoria, Ill.

1:00 p.m. **Cafeteria**

Luncheon

Toastmaster: *John Haydock,* editor, *Metal Working,* White Plains, N. Y.

Speaker: *Thorndike Saville,* dean, college of engineering, New York University, New York, N. Y.

Subject: **Early Engineering Education in the United States.**

2:30 p.m. **Auditorium**

Afternoon Session

Chairman: *C. Higbie Young,* emeritus professor The Cooper Union, New York, N. Y.

Vice-Chairman: *R. H. Nielsen,* president, Nielsen Hydraulic Equipment, Inc., New York, N. Y.

Panel discussion of the following papers:

Production Considerations in Machine Design—Effects of Design Upon the Manufacturing Cost of Machine Tools and Other Mechanical Elements, by *E. P. Bullard, 3rd,* Pratt & Whitney Aircraft Corp., East Hartford, Conn.

Mechanizing Machine Tools for Diversified Production, by *B. D. Smith,* International Harvester Co., Chicago, Ill.

Production Consideration in the Design of Heavy Machinery, by *C. A. Jurgensen,* DeLaval Steam Turbine Co., Trenton, N. J.

ASME Membership as of Jan. 31, 1955

Honorary Members	59
Fellows	394
Members	14,474
Affiliates	316
Associate Members (33 and over)	3,600
Associate Members (30-32)	3,165
Associate Members (to the age of 29)	18,397
Total	40,405

1955 ASME Regional Student Conferences

	Region	Place	Date	Host
I	New England	Boston, Mass.	April 22-23	Northeastern University
II	Eastern	Newark, N. J.	April 21	Newark College of Engineering
III	Alleghenies	Baltimore, Md.	April 29-30	The Johns Hopkins University
IV	Southern	Charlottesville, Va.	April 1-2 (R. A. C. Meeting April 2-3)	University of Virginia
V	Midwest	Toronto, Ont., Can.	April 29-30	University of Toronto
VI	Northern Tier	Minneapolis, Minn.	April 22-23	University of Minnesota
VI	Southern Tier	Peoria, Ill.	April 28-29	Bradley University
VII	Pacific Northwest	Corvallis, Ore.	May 4-6	Oregon State College
VII	Pacific Southwest	Berkeley, Calif.	May 5-6	University of California
VIII	Northern Tier	Norman, Okla.	April 18-19	University of Oklahoma
VIII	Rocky Mountain Tier	Albuquerque, N. Mex.	April 29-30	University of New Mexico
VIII	Southern Tier	Houston, Texas	April 25-26	Rice Institute

ASME-IME Joint Conference on Combustion to Be Held in Cambridge, Mass., June 15–17

The program of the joint ASME-IME International Combustion Conference, scheduled for June 15–17, at Massachusetts Institute of Technology, Cambridge, Mass., is now practically complete.

For sake of uniformity, all the papers are being printed abroad and, following British practice, they will be summarized by reporters instead of being presented in full by the authors. However, the latter will be given opportunity for rebuttal. In this way, it should be possible to cover the 40 papers in five three-hour sessions and leave the final session for supplementary discussions.

Technical Sessions

The papers will be preprinted in five groups corresponding to the sessions. The first, or opening, session will be of a general character and consist of three technical papers in addition to remarks by representatives of the two Societies.

The second session will deal with boilers, the third with industrial furnaces, the fourth with internal-combustion engines, and the fifth with gas turbines.

Social Events

There will be a banquet on Thursday evening, June 16, and an informal get-together with some form of entertainment on Wednesday evening. As yet, plans are incomplete for entertaining those British guests who may contemplate remaining over for the ASME Diamond Jubilee Semi-Annual Meeting in Boston, Mass., June 19–23.

All sessions will be held at M.I.T. where meals will be available at either the cafeteria or the Faculty Club. Blocks of rooms at both the Hotel Statler, in Boston, and the new M.I.T. dormitories have been reserved for housing visitors from home and abroad. Advance registration will be handled through ASME Headquarters and blanks will be available at a later date.

The Institution of Mechanical Engineers is planning to repeat the Conference in London, England, in October, after which proceedings of both meetings will be printed.

ASME Participates in First EJC General Assembly to Discuss Engineering Problems

Employment Conditions, Nuclear Energy, Engineering Manpower, EJC Accomplishments, Leading Topics

Engineers Joint Council held its first general assembly—a day-long program of open presentations and discussions—on January 21, in New York, N. Y. EJC is constituted of eight major engineering societies, of which The American Society of Mechanical Engineers is one.

From every standpoint the conclave was an outstanding success—range of subjects, attendance, and participation.

The attendance, approaching 400, represented not only the constituent organizations, but also several others of large importance. Included were many of the nation's leaders in engineering, science, and industry. In the panels and forums, the Government was represented by several spokesmen.

The spirit and hopes with which EJC had entered upon its first General Assembly were outlined by Thorndike Saville, dean of engineering, New York University, recently elected to his second term as President of EJC.

Nuclear Congress

The General Assembly served as an occasion for further announcement of details of the Nuclear Congress to be held, under EJC sponsorship and with the participation of other organizations, Dec. 12–16, 1955, in Cleveland, Ohio. The broad scope of this convention, momentous in its goals and magnitude were related by John R. Dunning, Mem. ASME, General Chairman of the EJC Committee on Nuclear Engineering and Science, dean of the school of engineering, Columbia University, and by Donald L. Katz, Program Chairman for the Nuclear Congress, chairman of the department of chemical and metallurgical engineering, University of Michigan.

Atomic Energy Changes Engineering

In a discussion of "Engineering Changes Introduced by Atomic Energy," Miles C. Leverett, engineering manager, aircraft-nuclear propulsion, General Electric Company, Cincinnati, Ohio, said that there has been "brought about an increasing awareness of the value of good fundamental training and of the value of engineers sufficiently broad in outlook and sufficiently flexible so that they can think and operate effectively in a number of technical fields."

People with such characteristics and training are not commonly found, he said. In his experience, it has proved feasible and desirable to create such people by intentionally throwing carefully selected mechanical, chemical, and electrical engineers into the heart of our reactor-physics activities for six months to two years.

Mr. Leverett added, "Another striking feature of the nuclear-engineer's position is that his opportunity for advancement is great. One person in six in the nuclear-energy industry is primarily technical in background or function. The industry, at present, is dominated by considerations of technical feasibility. Only recently has the more usual dominance of cost considerations come to play an important part. This tends to give the technical-trained person an unusually large share in the direction and management of the over-all enterprise."

Commenting on the "mobility" of the individual, Mr. Leverett said, "In the nuclear-energy industry it is exceptional to find an individual of stature who has not worked at a number of installations and for a number of employers. This has had a strongly broadening effect on the technical component of the industry, which certainly is beneficial."

"One noticeable characteristic of the nuclear-energy industry," he said, "is its growing similarity to the aircraft industry. In both cases, the Federal Government is the primary customer. Both industries are dominated primarily by military considerations. Both have a high percentage of technical content. There is a considerable amount of government ownership of production facilities."

With equal directness, the banquet speaker, Donald A. Quarles, Assistant Secretary of Defense, in Research and Development, took up the subject of "Engineers and Our National Well-Being."

"Perhaps the most important thing the communists have done," Mr. Quarles said, "has been to modernize their educational system and to orient it strongly toward the physical sciences and industrial technology. They have increased their scientific and technological potential by an order of magnitude. They are turning out engineers and scientists at more than twice the rate in this country. If current trends continue, it will be a matter of only a few years before their scientific and technical manpower exceeds ours."

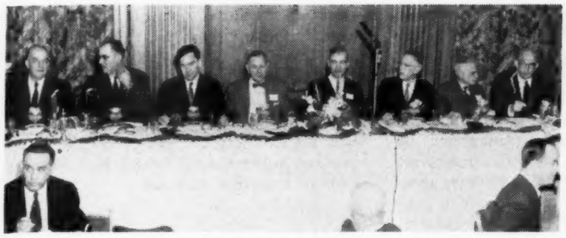
It is important, he remarked, for us to work toward national policies that enhance and conserve engineering manpower. He asserted that best utilization of available engineers requires that industrial and other employers of engineers must recognize their obligation to develop the full potential of each engineer and to avoid waste of his talents on nontechnical duties.

Research for National Defense

Half the total research and development potential of the nation, Mr. Quarles observed, is now engaged in atomic energy and aerodynamics studies for national defense.

"There are, of course, many by-products of value to our civilian economy. Nor does it imply that the nondenfense half is without benefit to defense, since, in the long-range sense, defense technology is founded in large measure on the fundamental research in our universities and similar institutions and on the technology developed in our civilian industry."

On nuclear engineering of the future, Mr. Quarles said "One can hardly deal with the matter of nuclear power without raising a



Section of the head table at the Banquet held during the first Engineers Joint Council General Assembly in New York, N. Y., January 21

Left to right: **Brig. Gen. Stewart E. Reimel (ret.), secretary, EJC; Harold S. Osborne; E. L. Chandler, treasurer, EJC; C. E. Davies, secretary, ASME; and G. B. Earnest**

basic question of national policy as to the proper place of the government in this field. The question is complicated by the fact that, for good and sufficient reasons, the government arrives at the present crossroads with an absolute monopoly and with national-security reasons for perpetuating some aspects of the monopoly. This poses a difficult question."

"On the one hand, it is apparent that, if we really believe in free enterprise and in getting government out of all business activities, except those necessary in the public interest and that cannot be properly performed by private enterprise, then the time certainly has come to start getting the government out of the atomic-power business."

"On the other hand, there are plausible arguments that the people's money has been spent to develop the art and to produce fissionable or nuclear fuel and operate the power plants for the people." Of course, the hitch in this argument is the hidden premise that government operation of such power systems would be in the best interest of the people. I, at least," added Mr. Quarles, "believe it would not. Therefore I take great satisfaction in the enactment of the Cole-Hickenlooper Act, which, while not proscribing government operation, wisely provided for an orderly transition to private ownership and operation of nuclear-power facilities."

Engineering manpower and the history and activities of the Engineering Manpower Commission of EJC were major subjects of the General Assembly. The luncheon speaker, Dael Wolfle, of Washington, D. C., advised that substantial relief of the shortage of engineers, scientists, and other professionals could be achieved by a determined effort to induce qualified high-school graduates to proceed to college.

High-School Students for Engineering

Dr. Wolfle, administrative secretary, the American Association for the Advancement of Science, said "There is a supply which is not now being developed. It consists of bright high-school graduates who do not go to college. If arrangements could be made to get that group through college, the number of average or better college students could be doubled. The problem is partly economic. Many bright boys and girls do not have the money a college education would require. But, even more, the problem is social. Many bright boys and girls grow up without ever having been interested in developing and using their superior abilities."

Engineering Manpower

At the forum discussions on engineering manpower, Thomas H. Chilton, technical director, E. I. du Pont de Nemours & Company, Inc., was chairman. Participants included S. C. Hollister, dean, college of engineering, Cornell University; M. H. Trytten, director, Office of Scientific Personnel, National Research Council and consultant to Engineering Manpower Commission; Carlton S. Dargusch, consultant to EMC; James M. Mitchell, Deputy Assistant Secretary of Defense, Manpower Personnel; Norman A. Shepard, chemical director, American Cyanamid Company; H. A. Meyerhoff, executive director, Scientific Manpower Commission; and Commander Carrison, of the Navy.

Mr. Mitchell and Commander Carrison explained the Government's proposed national-reserve plan.

Employment and Unionization

In opening the panel and discussion on "Employment Conditions and Unionization—Their Effect on the Engineer," G. Brooks Earnest, chairman, made a revealing report on a questionnaire submitted to the members by ASCE, ASME, and AIEE, which have a total membership of 127,000. Dr. Earnest, president, Fenn College, Cleveland, Ohio, said the results were being presented for the first time. Of the 112,225 questionnaires mailed (certain membership classifications were not included), 64,206 or 57 per cent responded.

Mr. Earnest said "of the 64,206, only 2348 or about 3.7 per cent were actually members of an established collective-bargaining group. However, 17,318 or 27 per cent reported as not being opposed to collective bargaining. Furthermore, 12,833 or 20 per cent reported they believed collective bargaining would be advantageous to them. Of 8199 reporting from two member societies in this category (the third did not ask the question), 347 or about 0.9 per cent would prefer to be represented by a craft or labor union."

"It is important to note that 45,992 or 72 per cent of the 64,206 returns opposed collective bargaining for professional engineers and that 42,314 or 66 per cent felt collective bargaining is incompatible with professional status."

"The results of the questionnaires from these three societies present a challenge to the engineering profession. We do not know the thinking of the remaining 43 per cent of the 112,225 members polled who did not respond. But assuming it might approximate the thinking of the 57 per cent responding, there then would be 31,500 members who are not opposed to collective bargaining for professional engineers. We are charged with the responsibility of first converting 31,500 of our own members to the true professional-status category."

"These percentages, resulting from questionnaires to members of three constituent societies of EJC, 'point up' the missionary work ahead of us in spite of the permissive clauses in the Taft-Hartley Act."

Collective Bargaining

On the question, "Is collective bargaining compatible with professionalism?" an emphatic negative was voiced by Nathan W. Dougherty, dean of the college of engineering, University of Tennessee, member of the EJC Committee on Employment Conditions.

"Bargaining groups cannot grow into unity groups or professional associations," reminded Dean Dougherty. "They are committed to the concept of jurisdictions rather than performance with requisite knowledge and skill. They must emphasize seniority to hold their membership and strength. Jurisdictions and seniority are in direct conflict with the concept that ability must be recognized and given first place. To a professional, the sole criterion of the work he must do is his ability to perform with needed knowledge and responsibility. . . .When working conditions are determined by group action the very nature of professionalism is violated. . . .Why should a professional have to turn to collectivism to get a salary raise? If such conditions exist, it is because professionals in management are not assuming their responsibility. . . . Any connection or pressure from management or fellow workers, which tends to reduce the engineer's freedom to make judgments, is a menace to his status and harmful to his position."

The figures reported by Chairman Earnest moved E. Lawrence Chandler, assistant secretary, ASCE, and treasurer of EJC, to comment: "Even though only a little more than 3 per cent of the membership of the three societies are members of unions, we are challenged by the circumstances that so many express a

favorable reaction in spite of the fact that the essence of collective bargaining is so foreign to the basic concept of professionalism and to the fundamental thinking inherent in creative engineering."

"A basic responsibility of management to the engineer is management's obligation to see that the young engineer is properly oriented and indoctrinated into the practicing technological world," Mr. Chandler said.

"Members of the engineering profession can attain fulfillment of their maximum potential only if their education is continued. A true concept of professionalism demands that education be a lifelong function and the employer of engineers is obligated to see that his technical personnel are given maximum opportunity for such continued training.

"Most important is the need to be certain that employee engineers are assigned to engineering work. The dignity of the individual thus will be respected and his professional attitude maintained."

EJC Opportunities to Serve

Carlton S. Proctor, of New York, N. Y., was chairman of a panel on "Service Opportunities for Engineers Joint Council." Other participants included C. E. Davies, secretary, ASME, and Harold S. Osborne, of Montclair N. J. Postwar guidance to the government by EJC on German and Japanese economic aspects and the extensive efforts of EJC in the national water-policy field were among the many works of the organization reviewed in the discussions.

Officers Elected

At the annual meeting of EJC, held the evening before the General Assembly, Dr. Saville was named president for a second term. E. J. Kates, of New York, Mem. ASME, became vice-president. E. L. Chandler is treasurer. Brig. Gen. Stewart E. Reimel (ret.), of Washington, Mem. ASME, is secretary and E. P. Lange, of New York, is assistant secretary.

ASME Ontario Section Holds First Management Seminar, Toronto, Ont., January 27

The Ontario Section of The American Society of Mechanical Engineers held its first Management Seminar on Thursday afternoon and evening of January 27. The afternoon session, held at the University of Toronto, was under the chairmanship of the ASME Management Division Chairman, L. E. Newman. Four eminent speakers dealt with "Executive Practices," "Industrial Engineering," "Sales Management," and "The Human Equation in Management."

Executive Practices

In his discussion of executive practices C. H. Van Horne, a supervising engineer with Stevenson and Kellogg in Toronto, contended that although labor unions and social-welfare programs are well advanced throughout Canada, both putting the pressure on costs, the art and science of management as a national endeavor is still in its infancy and must be pursued more actively if we are to hold the line on costs. Mr. Van Horne called attention to our Society's close historical connection with the development of scientific management by reference to F. W. Taylor's contribution before the Society at Saratoga, N. Y., 52 years ago.

T. C. Graham, head of the Institute of Business Administration in Toronto, discussed industrial engineering by first defining it after Dr. Lillian Gilbreth's definition—"An Engineer is a person who believes in measurement, who knows how to measure, does measure, and is willing to abide by the results of this measurement." He showed how the industrial engineer of today is really yesterday's efficiency expert in the process of growing up. Professor Graham touched on the subject of monotony in today's repetitive piecework production, which sparked a lively discussion.

Sales Management was handled by S. E. Erskine, manager, Sales Apparatus Division, Canadian General Electric Company. Mr. Erskine based his talk largely on the new marketing plan developed by General Electric Company since the war. The plan, evolved after a thorough study of all the company's operating departments, is now widely copied in other industries.

Human Equation in Management

H. Moore, director of Psychological Service Centre, Toronto, precipitated the most lively discussion by his presentation of the human equation in management. He felt that this area of management had suffered because, like other fields of social science, it has not attracted the level of mentality and people with the daring qualities that have been attracted to the physical sciences. Dr. Moore ridiculed the idea that human behavior can be equated. He maintained that if we are to successfully deal with interpersonal relations, we must gain an appreciation of the hopes, the goals, the values, and ideals of those we seek to influence.

D. G. Darling, Ontario Section Chairman, presided over the evening session, which featured a talk by Phil Carroll, time-study consultant and Fellow ASME. Mr. Darling commented on the 75th Anniversary of the Society and made a certificate presentation to Past-Chairman Deane Pannabaker and awarded a 75th Anniversary medal to C. R. Davis in recognition of his service to the Society and general engineering attainment. Professor Allcut of the University of Toronto was cited for his appointment to the Power Test Codes Committee; Frank G. East for his 1954 ASME Machine-Tool Award.

Production Management

Mr. Carroll spoke on the subject of production-management errors from the viewpoint of the time-study specialist. By citing examples of nonprofit items allegedly produced at a profit, and profitable items loaded with costs not properly belonging to them, he demonstrated how much of our industrial management is deceived into a feeling of false security. He emphasized the need for an accurate determination and breakdown of costs on each item if true manufacturing efficiency is to be achieved.

Mr. Carroll left his audience thoroughly convinced that, through the application of time study in its broadest sense, a largely untapped reserve is available to much of North America's industry, which should counter the trend toward higher costs and preserve "the lower costs and higher wages" which is the basis of the high standards we enjoy.

ASME Calendar of Coming Events

March 20–23
ASME Heat Transfer Division and the American Institute of Chemical Engineers Symposium, Kentucky Hotel, Louisville, Ky.
(Final date for submitting papers was Nov. 1, 1954)

March 23–24
ASME Management Conference, Hotel Statler, Cleveland, Ohio
(Final date for submitting papers was Nov. 1, 1954)

April 6
ASME Machine Design Division Conference, as part of the Centennial Celebration, New York University's College of Engineering, New York, N. Y.

April 16
The Organization Anniversary Meeting, Stevens Institute of Technology, Hoboken, N. J.
(No formal papers will be presented)

April 18–21
Diamond Jubilee Spring Meeting, Lord Baltimore and Southern Hotels, Baltimore, Md.
(Final date for submitting papers was Dec. 1, 1954)

April 25–26
ASME Instruments and Regulators Conference, University of Michigan, Ann Arbor, Mich.
(Final date for submitting papers was Dec. 1, 1954)

June 5–10
ASME Oil and Gas Power Conference, Hotel Statler, Washington, D. C.
(Final date for submitting papers was Feb. 1, 1955)

June 15–17
ASME and The Institution of Mechanical Engineers, London, England, Joint Conference on Combustion, Massachusetts Institute of Technology, Cambridge, Mass.
(Final date for submitting invited papers was Nov. 1, 1954)

June 16–18
ASME Applied Mechanics Conference, Rensselaer Polytechnic Institute, Troy, N. Y.
(Final date for submitting papers was Feb. 1, 1955)

June 19–23
Diamond Jubilee Semi-Annual Meeting, Hotel Statler, Boston, Mass.
(Final date for submitting papers was Feb. 1, 1955)

Sept. 12–16
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Los Angeles, Calif.
(Final date for submitting papers—May 1, 1955)

Sept. 25–28
ASME Petroleum-Mechanical Engineering Conference, Roosevelt Hotel, New Orleans, La.
(Final date for submitting papers—May 1, 1955)

Oct. 10–12
ASME-ASLE Second Lubrication Conference, Antlers Hotel, Indianapolis, Ind.
(Final date for submitting papers June 1, 1955)

October 19–20
ASME-AIME Joint Fuels Conference, Niel House, Columbus, Ohio
(Final date for submitting papers—June 1, 1955)

Nov. 13–18
Diamond Jubilee Annual Meeting, Hotel Congress, Chicago, Ill.
(Final date for submitting papers—July 1, 1955)
(For Meetings of Other Societies, see page 291)

1955 American Power Conference Program to Be Held in Chicago Has Wide ASME Participation

Utilization of new sources of energy among principal topics for discussion

The seventeenth annual meeting of the American Power Conference will be held March 30 through April 1, 1955, in the Sherman Hotel, Chicago, Ill. A program of interest to those engaged in practically every phase of the power industry has been arranged on the use of nuclear and solar energy according to the preliminary program released by Illinois Institute of Technology, which sponsors the conference in co-operation with 14 universities and The American Society of Mechanical Engineers among the nine co-operating engineering societies.

Technical Program High Lights

The technical program includes several sessions devoted to central station and industrial power plants, steam and gas turbines, boilers, fuels, water technology, atomic energy, and the generation, transmission, distribution, and utilization of power.

The opening-day program will be highlighted by a panel on the development of atomic energy for power purposes. The Hon. Bourke B. Hickenlooper, U. S. Senator from Iowa, member of the joint Congressional Committee on Atomic Energy, will serve as moderator. Members of the panel, scheduled for 7:30 p.m., Wednesday, March 30, include Philip Sporn, Fellow ASME, representing the nuclear-power group, and W. L. Cisler, Fellow ASME, representing the Atomic Power Development Associates. A second session on nuclear power for the discussion of progress in nuclear technology for power generation will be held on Friday, April 1, at 2:00 p.m.

Other sessions will take up such subjects as the efforts to capture energy from the sun's rays, the St. Lawrence Seaway, fault location with radar equipment, the impact of air conditioning on the electric-utility industry. Also included among the topics to be considered are: Principles of automatic controls and the importance of complete co-operation of heavy equipment manufacturers with utilities; research on natural-gas substitutes, coal, and petroleum.

Conference Proceedings

Each year all papers and addresses delivered at the Conference are published in a clothbound volume called "The Proceedings of the American Power Conference." A copy of this volume will be mailed without further charge to each registrant. Additional copies may be ordered at the registration desk or by mail. The price of the volume will be $6. A number of copies of the Proceedings of previous meetings of the American Power Conference will also be on sale and may be purchased at the registration desk.

Technical Program

Sessions of particular interest to mechanical engineers have been selected from the program and follow:

WEDNESDAY, MARCH 30

9:00 a.m. — **Mezzanine Floor**

Registration

10:00 a.m. — **Grand Ballroom**

Opening Meeting

Chairman: *A. A. Potter*, president, Bituminous Coal Research, Inc., and dean emeritus, Purdue University

Associate Chairman: *H. A. Leedy*, vice-president and director, Armour Research Foundation

Invocation

Where We Stand Today in the Electric Industry, *J. W. Evers*, president, Commonwealth Edison Co.

Research in the Electric-Utility Industry, *H. P. Seelye*, manager of engineering, The Detroit Edison Co.

12:15 p.m. — **Bal Tabarin Room**

American Power Conference Luncheon

Sponsored by The American Society of Mechanical Engineers

Chairman: *David W. R. Morgan*, ASME President, and vice-president, Westinghouse Electric Corp.

Associate Chairman: *Frank Cotterman*, chairman, Chicago Section, ASME, and assistant directing engineer, Engineering Laboratories, Crane Co.

Speaker: *Harold Quinton*, president, Edison Electric Institute, and president, Southern California Edison Co.

Subject: **Engineers and The Electric Utilities**

2:00 p.m — **Grand Ballroom**

Central-Station Steam Generators

Chairman: *H. H. Hemenway, Jr.*, chief engineer, Steam Division, Foster Wheeler Corp.

Associate Chairman: *R. C. Porter*, professor of mechanical engineering, University of Michigan

The Monotube or Once-Through Boiler for Standard or Supercritical Pressures. *A. T. Hunter*, vice-president, Combustion Engineering, Inc.

The Operation of Large Central-Station Steam Generators. *G. V. Williamson*, vice-president, and *J. K. Bryan*, assistant to superintendent, Production, Union Electric Co. of Missouri

2:00 p.m. — **Louis XVI Room**

Water Resources

Chairman: *R. H. Bradford*, regional manager, Ebasco Services Inc.

Associate Chairman: *E. M. Fucik*, executive vice-president, Harza Engineering Co.

St. Lawrence Seaway—Progress Report and Economic Outlook, *R. F. Stellar*, engineer, St. Lawrence Seaway Development Corp.

Utilization of Saline Waters. *D. S. Jenkins*, Department of the Interior, Washington, D. C.

Some Effects of Precipitation on Ground Water in Wisconsin. *W. J. Drescher*, district geologist, Ground Water Branch, Water Resources Division, U. S. Geological Survey, Madison, Wis.

Use of Water for Irrigation, Navigation, and Power. *R. J. Pafford, Jr.*, head hydraulic engineer, Missouri River Division, Corps of Engineers, Omaha, Neb.

2:00 p.m. — **Assembly Room**

Industrial Steam and Power

Chairman: *C. R. Earle*, executive editor, *Power Engineering*

Associate Chairman: *G. A. Mierendorf*, superintendent of power plants, A. O. Smith Co.

When Should Industry Generate Electricity? *M. L. Jones*, principal power engineer, E. I. du Pont de Nemours & Co., Inc.

Let's Take the Guesswork Out of Industrial Power Costs. *F. B. Banton*, consulting engineer, Downers Grove, Ill.

Fast Starting of 150,000-lb Per Hr Industrial Boilers. *C. E. Morrow*, factory planning engineer, and *R. F. Born*, mechanical engineer, Western Electric Co.

How to Reduce Spreader Stoker Fly Ash. *C. H. Morrow*, chief plant engineer, J. I. Case Co.

3:30 p.m. — **Grand Ballroom**

Research in Steam Generators

Chairman: *H. L. Solberg*, head, department of mechanical engineering, Purdue University

Associate Chairman: *J. J. Kanter*, directing engineer, Engineering Laboratories, Crane Co.

Research in the Field of Steam Generators:

L. S. Wilcoxson, vice-president, The Babcock and Wilcox Co.

W. H. Armacost, vice-president, Combustion-Engineering, Inc.

Evening Forum

7:30 p.m. — **Grand Ballroom**

Industrial Development of Atomic Energy

Chairman: *T. G. LeClair*, engineering assistant to vice-president, Commonwealth Edison Co.

Moderator: The Hon. *Bourke B. Hickenlooper*, United States Senator and Member, Joint Committee on Atomic Energy, Washington, D. C.

Panel Members:

W. L. Cisler, president, The Detroit Edison Co. Representing the Atomic Power Development Associates consisting of 25 utilities, four engineering firms, and three industrial firms

Philip Sporn, president, American Gas and Electric Service Corp. Representing the Nuclear Power Group consisting of American Gas and Electric Service Corp., Bechtel Corp., Commonwealth Edison Co., Pacific Gas and Electric Co., and Union Electric Co. of Missouri

William Webster, executive vice-president, New England Electric System, and president, The Yankee Atomic Electric Company, a group of 12 utilities

J. F. Fairman, vice-president—engineering, Consolidated Edison Co.

THURSDAY, MARCH 31

9:00 a.m. — **Grand Ballroom**

Research in Steam Turbines

Chairman: *A. A. Potter*, president, Bituminous Coal Research, Inc., and dean emeritus, Purdue University

Associate Chairman: *Frank D. Carvin*, head, department of mechanical engineering, Illinois Institute of Technology

Advances in Large Steam-Turbine Research and Development. *H. D. Emmert*, assistant chief engineer, Steam Turbine Section, Allis-Chalmers Manufacturing Co.

The Development Laboratory as an Engineering Tool in Research and Development in the Field of Steam Turbines and Auxiliaries. *F. K. Fischer*, manager, development engineering, Steam Division, Westinghouse Electric Co.

Research and Development in the Field of Turbine-Generator Prime Movers in the General Electric Company. *G. B. Warren*, vice-president and general manager, Turbine Division, General Electric Co.

9:00 a.m. — **Assembly Room**

Water Technology I

Symposium: Operation of Demineralizers for Treating Make-Up for Steam-Power Plants

Chairman: *Louis Wirth, Jr.*, chairman, Water Technology Division, Chicago Section, ASME, and special service engineer, Ion Exchange Division, National Aluminate Corp.

Associate Chairman: *W. R. Homan*, chemical engineer, Commonwealth Edison Co.

Demineralization of Make-Up for Public-Utility Plants. *J. A. Wallace*, assistant general production manager, and *L. W. White*, chemical engineer, Iowa Electric Light and Power Co.

Demineralization of Boiler-Feed Make-Up for Paper Mills. *T. J. Judge*, power co-ordinator and division power engineer, and *C. L. Davis, Jr.*, chemical engineer, International Paper Co.

Treatment of Make-Up Water With a Four-Bed Demineralizing Plant. *W. M. Mayer*, results engineer, Central Power and Light Co.

Treatment of Make-Up Water with Automatic Mixed-Bed Demineralizer. *S. F. Borgel*, mechanical engineer, Pennsylvania Electric Co.; *J. H. Brendlen*, engineering department, Gilbert Associates, Inc.; and *V. J. Calise*, vice-president, Graver Water Conditioning Co.

9:00 a.m. **Louix XVI Room**

Industrial Applications

Chairman: *F. A. Compton*, vice-president, Detroit Edison Co.

Associate Chairman: *D. G. Ryan*, professor of mechanical engineering, University of Illinois.

The Impact of Air Conditioning on the Electric-Utility Industry. *Fischer Black*, editor and publisher, *Electrical World*

Automatic Controls—Their Effect on Industry. *John Diebold*, management consultant, John Diebold and Associates, Inc., and editor and publisher, *Automatic Controls*

The Importance of Complete Co-Operation of Heavy Equipment Manufacturers With Utilities. *O. V. Tally*, director of industrial sales, Allis-Chalmers Manufacturing Co.

12:15 p.m. **Bal Tabarin Room**

American Power Conference Luncheon

Sponsored by the American Institute of Electrical Engineers

Chairman: *A. C. Monteith*, president, AIEE, and vice-president, Westinghouse Electric Corp.

Associate Chairman: *H. R. Heckendorn*, chairman, Chicago Section, AIEE, and assistant superintendent, manufacturing engineering, Western Electric Co.

Speaker: *C. H. Linder*, vice-president, General Electric Co.

2:00 p.m. **Grand Ballroom**

Central-Station Power Plant

Chairman: *R. D. Maxson*, vice-president, Commonwealth Edison Co.

Associate Chairman: *E. C. Lundquist*, professor of mechanical engineering, State University of Iowa

Central-Station Design for Over-All Economy. *Paul Gourdon*, consulting mechanical Engineer, Ebasco Services Inc.

Dynamic Behavior of Power-Plant Stacks Under Wind Loading. *C. G. Merriman*, civil engineer, and *Sacid Ozker*, assistant division supervisor, mechanics division, engineering laboratory and research department, Detroit Edison Co.

Foundation Problems in Power-Plant Design and Construction. *W. S. Housel*, professor of civil engineering, University of Michigan

2:00 p.m. **Crystal Room**

Research in Fuels

Chairman: *L. C. McCabe*, chief, Fuels and Explosives Division, Bureau of Mines, United States Department of the Interior, Washington, D. C.

Associate Chairman: *Martin Elliott*, professor of mechanical engineering, Illinois Institute of Technology

Probable Trend in Coal-Freight Rates. *F. K. Edwards*, director, Department of Coal Economics, National Coal Assoc.

Research in Natural-Gas Substitutes. *E. S. Pettyjohn*, vice-president and director, Institute of Gas Technology

Research in Coal Industry. *H. J. Rose*, vice-president and director of research, Bituminous Coal Research, Inc.

Research in the Petroleum Industry. *J. K. Roberts*, general manager, Research and Development, Standard Oil Co. of Indiana

2:00 p.m. **Assembly Room**

Developments in Small Gas Turbines

Chairman: *W. P. Green*, manager, Heat-Power Division, Armour Research Foundation.

Associate Chairman: *N. A. Hall*, professor of mechanical engineering, University of Minnesota

Research and Development of an Experimental Rotary Regenerator for Automotive Gas Turbines. *W. W. Chao*, gas-turbine department, Scientific Laboratory, Ford Motor Co.

Progress in Automotive Gas Turbines. *S. D. Hage*, chief project engineer, gas-turbine department, Boeing Airplane Co.

3:30 p.m. **Assembly Room**

Automatic Generating Equipment for Utilities

Chairman: *E. L. Dahlund*, chief engineer, diesel-engineering department, Fairbanks, Morse and Co.

Associate Chairman: *R. Tom Sawyer*, manager, research department, American Locomotive Co.

Mobile Electric Automatic Generating Equipment for Utilities. *B. H. Hefner*, chief electrical engineer; *K. O. Bower*, A-C Engineer; and *E. A. Armstrong*, consultant, Electro-Motive Division, General Motors Corp.

Starting Characteristics of Isolated Large Diesel Generators With Initial A-C Load. *Leo Brinson*, product engineer, Nordberg Manufacturing Co.; *A. H. Hoffmann*, design engineer, Westinghouse Electric Corp.; and *R. W. Flugum*, consulting and application engineer, Westinghouse Electric Corp.

6:45 p.m. **Grand Ballroom**

All Engineers Dinner

Presiding: *Fischer Black*, editor, *Electrical World*, The University of Illinois Choir, *Paul Young*, Director

Speaker: *Alexander M. Beebee*, president, Rochester Gas and Electric Company, Rochester, N. Y.

FRIDAY, APRIL 1

9:00 a.m. **Grand Ballroom**

Gas Turbines for Power Plants

Chairman: *J. I. Yellott*, director of research, Locomotive Development Committee, Bituminous Coal Research, Inc.

Associate Chairman: *B. G. A. Skrotzki*, associate editor, *Power*, McGraw-Hill Publishing Co.

Combined Gas-Turbine Steam-Turbine Power-Plant Cycles. *A. A. Hafner*, manager, Production Planning and Marketing Research, Gas Turbine Division, and *W. B. Wilson*, manager, Power Generation Engineering, Industrial Engineering Section, General Electric Co.

5000-hp Dual-Shaft Gas-Turbine Power Plant. *J. O. Stephens* and *D. F. Bruce*, Gas Turbine Engineering, Westinghouse Electric Corp.

Application of Gas Turbines to Nuclear-Power Plants. *H. E. Grantz*, manager, and *B. H. Neuffer*, power-plant analyst, Atomic Power Equipment Engineering Subsection, General Electric Co.

9:00 a.m. **Assembly Room**

Cooling Towers for Central-Station Plants

Chairman: *A. R. LeBailly*, partner, Sargent and Lundy

Associate Chairman: *J. T. Anderson*, department of mechanical engineering, Michigan State College

Cooling Towers—Their Influence on Prospective Plant Sites. *R. W. Gaussmann*, power-production engineer, Indianapolis Power and Light Co.

Cooling Towers for the Power Industry. *F. J. Lockhart*, manager of product development; *J. M. Whitesell*, chief products-development engineer; and *A. C. Catland, Jr.*, senior contract-administration engineer, The Fluor Corporation, Ltd.

9:00 a.m. **Crystal Room**

Water Technology II

Chairman: *L. N. Scharnberg*, general chairman, Engineers' Society of Western Pennsylvania Water Conference

Associate Chairman: *M. B. Golber*, head power-plant engineer, Armour and Co.

Centralized Control of Boiler and Feedwater Chemical Treatment of the Valley Steam Plant. *R. C. Alexander*, superintendent, and *Jack Kotenthal*, laboratory technician, Valley Steam Plant, Department of Water and Power, Los Angeles, Calif.

Application and Treatment of Water for Heat-Pump Systems. C. W. Millsom, vice-president, Acme Industries

9:00 a.m. **Louix XVI Room**

Electrical-System Planning I

Chairman: *E. A. Cooper*, chairman, Power Group, Chicago Section, AIEE, and electrical engineer, Harza Engineering Co.

Associate Chairman: *E. B. Eggers*, research engineer, Illinois Institute of Technology

Planning Systems for Long-Range Growth. *H. L. Melvin*, chief consulting engineer, Ebasco Services Inc.

Location of Future Generation—Economic Analysis. *G. P. Wilson*, manager, of power production, Illinois Power Co.

10:30 a.m. **Louis XVI Room**

Electrical-System Planning II

Chairman: *W. A. Lewis*, dean of the Graduate School. Illinois Institute of Technology

Associate Chairman: *E. L. Nicholson*, manager, engineering, General Electric Co.

The Function of Land-Use Surveys in Power Planning. *E. L. Kanouse*, assistant engineer of construction and design, and *J. W. Reinhard*, electrical engineering associate, Department of Water and Power, Los Angeles, Calif.

Possibilities for Greater Regional Co-Ordination of Power Systems in the United States. *F. L. Adams*, chief, Bureau of Power, Federal Power Commission, Washington, D. C.

10:30 a.m. **Crystal Room**

Water Technology III

Chairman: *W. L. Jackson*, vice-chairman, Power Station Subcommittee, Prime Movers Committee, Edison Electric Institute

Associate Chairman: *Seldon Adkins*, director, Technical Service, Boiler Feedwater, National Aluminate Corp.

Conditions Where Sticking of High-Pressure Steam Valves May Occur. *C. L. Mead*, design engineer, General Electric Co.

Blue-Blush Characteristics. *F. G. Straub*, research professor of chemical engineering, University of Illinois

10:30 a.m. **Assembly Room**

Industrial Steam Generators

Chairman: *Ben G. Elliott*, chairman, department of mechanical engineering, University of Wisconsin.

Associate Chairman: *N. L. Markerich*, co-chairman, Power and Fuels Division, Chicago Section, ASME

Air Preheater for Small Power Plants. *W. F. Hammond*, chief engineer, and *C. L. Brown*, technical consultant, Air Preheater Corp.

Standard Steam Generators—Influence of Design Changes on Cost. *D. Cassino*, design engineer, Foster Wheeler Corp.

12:15 p.m. **Bal Tabarin Room**

American Power Conference Luncheon

Sponsored by the Western Society of Engineers.

Chairman: *J. F. Sullivan, Jr.*, president, Western Society of Engineers and manager of construction, Commonwealth Edison Co.

Associate Chairman: *R. G. Owens*, dean of engineering, Illinois Institute of Technology

Speaker: *Farrington Daniels*, chairman, department of chemistry, University of Wisconsin

Subject: *Solar Energy.*

2:00 p.m. **Grand Ballroom**

Progress in Nuclear Technology for Power Generation

Chairman: *D. H. Loughridge*, dean of engineering, Northwestern Technological Institute

Associate Chairman: *A. W. Kramer*, editor, *Power Engineering*

The Nuclear Plant as a Part of Future Power Systems, *B. R. Prentice*, manager, Atomic Power Studies, and *A. G. Mellor*, application engineer, Electric-Utility Engineering, General Electric Co.

Reactor Research and Development. *W. K. Davis*, deputy director, Division of Reactor Development, Atomic Energy Commission, Washington, D. C.

Sodium-Graphite Reactor Power Plants. *Chauncey Starr*, manager, nuclear engineering and manufacturing, North American Aviation, Inc.

Power From Atomic Energy. *J. W. Landis*, sales manager, Atomic Energy Division, The Babcock and Wilcox Co.

2:00 p.m. **Louix XVI Room**

Water Technology IV

Sponsored by Joint Research Committee on Boiler Feedwater Studies

Chairman: *P. B. Place*, 1st vice-chairman, Joint Research Committee on Boiler Feedwater Studies, research department, Combustion Engineering, Inc.

Associate Chairman: *T. J. Hodan*, manager, water-conditioning department, Allis-Chalmers Manufacturing Co.

Filming Amines—Use and Misuse in Power-Plant Water-Steam Cycles. *J. F. Wilkes*, director of research and product development; *W. L. Denman*, directing chemist, Dearborn Chemical Company; and *M. F. Obrecht*, department of chemical engineering and water-treatment consultant, Michigan State College

Experience with Filming Amines for Improving Heat Transfer. *J. G. Weidman*, engineering department, W. H. & L. D. Betz

Junior Forum . . .

Conducted by R. A. Cederberg,[1] Assoc. Mem. ASME

A Liberal Education

By F. Everett Reed,[2] Mem. ASME

We often hear about the importance of engineers studying the humanities in order to give breadth to their education. This is important because such studies give the engineer perspective to see aspects of his work other than the immediate problem at hand; they assist him in developing the ability to express himself; they help him to understand his fellow men and his society; they help him to be a better citizen; they acquaint him with the great thinkers who have provided the foundations of our civilization; and they give him a source of inspiration and recreation which is uplifting when discouraged, soothing when upset, humbling when conceited, and of a type which will develop his character.

Engineering Process of Thought

However, my thesis here is not in the direction of humanities and a liberal education for engineers, but rather that a liberal-arts student needs some understanding of the engineering process of thought in order to have a liberal education. By the engineering process of thought, I mean the practice of breaking down complex problems into more easily comprehensible parts, solving the parts, and from these building up the solution.

Our present world is becoming too beset with complex problems and is getting to have too short a time constant to accept the trial-and-error solution of these problems on the basis of intuition, superstition, and prejudice. We need to break down our problems into parts which we can comprehend. We need to logically decide what are the controlling factors in a problem. We need to think in fundamental terms.

Scientific Method

The engineer has been singularly successful in applying the scientific method to engineering problems. Without prejudice he can say whether it is better economy to build a particular hydroelectric plant or a steam-power plant. This logical unprejudice thought practice has not been so successful as in its application to problems of government, social relations, or religion. This is partly true because social problems are much less tangible. However, we must remember that it was only a short time ago that calculations of the strength and deflection of a beam were similarly intangible.

Although the application of the scientific method is learned through mathematics and science, its biggest field of common application is probably in engineering. Even here the field is limited and engineering is not generally taught as a particular application of a broad general principle. There are steps being made to widen the field of application of the scientific method. One of these is the field of operations research which uses scientific methods to assist in solving some of the complex problems involved in executive decisions. Even where the problems cannot be handled in terms of numbers, the scientific method is still the most effective approach to a solution. Getting as many relevant data as practical, picking the major variables, analyzing the effect of each on the whole problem and, above all, being free from bias, prejudice, and preconceived notions are the basic necessities for any effective thinking process.

We need to strengthen our understanding of the fundamentals of our social behavior. We need to find out what are the variables which determine the stability of our economic system. We need to evaluate the elements on which we base our individual lives. Why am I living? What do I expect to give and to get from the world? How do my standards fit into society? How should I tie my life into the complexity of life around me?

In the feudal era, man could get along reasonably well by following tradition and his intuition. Now we have too much power at our disposal. Our social and economic system responds too rapidly to inflammatory and disturbing functions to permit the luxury of prejudice and fuzzy thinking. The same type of scientific thinking which has led to our material development must be applied to its control. We need more and better thinkers and analysts who have been trained to approach complex problems by first breaking them into understandable parts and then solving them by applying, without prejudice, appropriate fundamentals.

[1] Westinghouse Electric Corporation, Pittsburgh, Pa.

[2] Arthur D. Little, Inc., Cambridge, Mass. Junior Advisory Mem. ASME.

. . . Chairman's Corner[3]

This month I want to briefly discuss the Junior Forum which is conducted under the direction of the National Junior Committee. The Junior Forum is used to describe the activities of the National Junior Committee; to stimulate the younger members of the Society to greater participation in society affairs; report on the Junior Sessions at the various national meetings of the Society; discuss various phases of professional development and industry training methods; and report on some of the activities of the Section Junior Groups. It is intended as a sounding board for the problems and interests of the Associate Members of the Society, particularly the newer members in this group. It cannot be truthfully said that the Forum has accomplished all of these goals. We wonder why more of you do not attend the Annual, Semi-Annual, Spring, and Fall Meetings of the Society when they are held in your part of the country—particularly the National Junior Committee sessions at these meetings. We also wonder why more of you do not prepare papers for presentation at the various Society meetings.

If you have ideas as to how the Society can be of greater assistance to you and/or others, drop us a line through National Headquarters at 29 West 39th Street, New York 18, N. Y. We are not guaranteeing positive results in every case but feel that you will get action in many cases. Keep in mind that, if you wish to get the most from the Society, you have to give a little more now and then.

[3] Chairman of National Junior Committee, Charles T. Miller, Engineering Division, Curtis-Wright Corporation, Wright Aero Division, Wood-Ridge, N. J.

Columbia University Starting Pegram Atomic Laboratory

A nuclear-physics research building to house a new six-million-electron-volt accelerator has been started at Columbia University. The accelerator will be located on the campus.

In making the announcement, Grayson Kirk, president of Columbia, said the $350,000 structure would be known as the George B. Pegram Laboratory.

The Atomic Energy Commission is providing $295,000 toward the cost of the building. The remainder is to come from the university.

Dean George Braxton Pegram, Fellow ASME, is special adviser to the president of the university and in charge of negotiations involving government-aided research at Columbia, He had a major role in development of the nation's atomic-energy program.

Meetings of Other Societies...

March 14–15
Steel Founders' Society of America, annual meeting, Drake Hotel, Chicago, Ill.

March 14–16
Society of Automotive Engineers production meeting and forum, Netherland Plaza Hotel, Cincinnati, Ohio

March 28–29
American Institute of Electrical Engineers, materials-handling conference, Hotel Cleveland, Cleveland, Ohio

March 28–April 1
American Society for Metals and 24 other technical societies, including the ASME Southern California Section, ninth Western Metal Exposition, Pan-Pacific Auditorium, Los Angeles, Calif.; ASM, ninth Western Metal Congress, Ambassador Hotel, Los Angeles, Calif. Society for Nondestructive Testing and American Welding Society, technical sessions to be held as part of Congress. American Foundrymen's Society will meet March 28, also as part of the Congress

March 31–April 1
Symposium on boundary-layer effects in aerodynamics, National Physical Laboratory, Teddington, Middlesex, England

Treatment of Make-Up Water With a Four-Bed Demineralizing Plant. *W. M. Mayer,* results engineer, Central Power and Light Co.

Treatment of Make-Up Water with Automatic Mixed-Bed Demineralizer. *S. F. Borgel,* mechanical engineer, Pennsylvania Electric Co.; *J. H. Brendlen,* engineering department, Gilbert Associates, Inc.; and *V. J. Calise,* vice-president, Graver Water Conditioning Co.

9:00 a.m. **Louix XVI Room**

Industrial Applications

Chairman: *F. A. Compton,* vice-president, Detroit Edison Co.

Associate Chairman: *D. G. Ryan,* professor of mechanical engineering, University of Illinois.

The Impact of Air Conditioning on the Electric-Utility Industry. *Fischer Black,* editor and publisher, *Electrical World*

Automatic Controls—Their Effect on Industry. *John Diebold,* management consultant, John Diebold and Associates, Inc., and editor and publisher, *Automatic Controls*

The Importance of Complete Co-Operation of Heavy Equipment Manufacturers With Utilities. *O. V. Tally,* director of industrial sales, Allis-Chalmers Manufacturing Co.

12:15 p.m. **Bal Tabarin Room**

American Power Conference Luncheon

Sponsored by the American Institute of Electrical Engineers

Chairman: *A. C. Monteith,* president, AIEE, and vice-president, Westinghouse Electric Corp.

Associate Chairman: *H. R. Heckendorn,* chairman, Chicago Section, AIEE, and assistant superintendent, manufacturing engineering, Western Electric Co.

Speaker: *C. H. Linder,* vice-president, General Electric Co.

2:00 p.m. **Grand Ballroom**

Central-Station Power Plant

Chairman: *R. D. Maxson,* vice-president, Commonwealth Edison Co.

Associate Chairman: *E. C. Lundquist,* professor of mechanical engineering, State University of Iowa

Central-Station Design for Over-All Economy. *Paul Gourdon,* consulting mechanical Engineer, Ebasco Services Inc.

Dynamic Behavior of Power-Plant Stacks Under Wind Loading. *C. G. Merriman,* civil engineer, and *Sacid Ozker,* assistant division supervisor, mechanics division, engineering laboratory and research department, Detroit Edison Co.

Foundation Problems in Power-Plant Design and Construction. *W. S. Housel,* professor of civil engineering, University of Michigan

2:00 p.m. **Crystal Room**

Research in Fuels

Chairman: *L. C. McCabe,* chief, Fuels and Explosives Division, Bureau of Mines, United States Department of the Interior, Washington, D. C.

Associate Chairman: *Martin Elliott,* professor of mechanical engineering, Illinois Institute of Technology

Probable Trend in Coal-Freight Rates. *F. K. Edwards,* director, Department of Coal Economics, National Coal Assoc.

Research in Natural-Gas Substitutes. *E. S. Pettyjohn,* vice-president and director, Institute of Gas Technology

Research in Coal Industry. *H. J. Rose,* vice-president and director of research, Bituminous Coal Research, Inc.

Research in the Petroleum Industry. *J. K. Roberts,* general manager, Research and Development, Standard Oil Co. of Indiana

2:00 p.m. **Assembly Room**

Developments in Small Gas Turbines

Chairman: *W. P. Green,* manager, Heat-Power Division, Armour Research Foundation.

Associate Chairman: *N. A. Hall,* professor of mechanical engineering, University of Minnesota

Research and Development of an Experimental Rotary Regenerator for Automotive Gas Turbines. *W. W. Chao,* gas-turbine department, Scientific Laboratory, Ford Motor Co.

Progress in Automotive Gas Turbines. *S. D. Hage,* chief project engineer, gas-turbine department, Boeing Airplane Co.

3:30 p.m. **Assembly Room**

Automatic Generating Equipment for Utilities

Chairman: *E. L. Dahlund,* chief engineer, diesel-engineering department, Fairbanks, Morse and Co.

Associate Chairman: *R. Tom Sawyer,* manager, research department, American Locomotive Co.

Mobile Electric Automatic Generating Equipment for Utilities. *B. H. Hefner,* chief electrical engineer; *K. O. Bower,* A-C Engineer; and *E. A. Armstrong,* consultant, Electro-Motive Division, General Motors Corp.

Starting Characteristics of Isolated Large Diesel Generators With Initial A-C Load. *Leo Brinson,* product engineer, Nordberg Manufacturing Co.; *A. H. Hoffmann,* design engineer, Westinghouse Electric Corp.; and *R. W. Flugum,* consulting and application engineer, Westinghouse Electric Corp.

6:45 p.m. **Grand Ballroom**

All Engineers Dinner

Presiding: *Fischer Black,* editor, *Electrical World,* The University of Illinois Choir, *Paul Young,* Director

Speaker: *Alexander M. Beebee,* president, Rochester Gas and Electric Company, Rochester, N. Y.

FRIDAY, APRIL 1

9:00 a.m. **Grand Ballroom**

Gas Turbines for Power Plants

Chairman: *J. I. Yellott,* director of research, Locomotive Development Committee, Bituminous Coal Research, Inc.

Associate Chairman: *B. G. A. Skrotzki,* associate editor, *Power,* McGraw-Hill Publishing Co.

Combined Gas-Turbine Steam-Turbine Power-Plant Cycles. *A. A. Hafner,* manager, Production Planning and Marketing Research, Gas Turbine Division, and *W. B. Wilson,* manager, Power Generation Engineering, Industrial Engineering Section, General Electric Co.

5000-hp Dual-Shaft Gas-Turbine Power Plant. *J. O. Stephens* and *D. F. Bruce,* Gas Turbine Engineering, Westinghouse Electric Corp.

Application of Gas Turbines to Nuclear-Power Plants. *H. E. Grant,* manager, and *B. H. Neuffer,* power-plant analyst, Atomic Power Equipment Engineering Subsection, General Electric Co.

9:00 a.m. **Assembly Room**

Cooling Towers for Central-Station Plants

Chairman: *A. R. LeBailly,* partner, Sargent and Lundy

Associate Chairman: *J. T. Anderson,* department of mechanical engineering, Michigan State College

Cooling Towers—Their Influence on Prospective Plant Sites. *R. W. Gaussmann,* power-production engineer, Indianapolis Power and Light Co.

Cooling Towers for the Power Industry. *F. J. Lockhart,* manager of product development; *J. M. Whitesell,* chief products-development engineer; and *A. C. Catland, Jr.,* senior contract-administration engineer, The Fluor Corporation, Ltd.

9:00 a.m. **Crystal Room**

Water Technology II

Chairman: *L. N. Scharnberg,* general chairman, Engineers' Society of Western Pennsylvania Water Conference

Associate Chairman: *M. B. Golber,* head power-plant engineer, Armour and Co.

Centralized Control of Boiler and Feedwater Chemical Treatment of the Valley Steam Plant. *R. C. Alexander,* superintendent, and *Jack Kotenthal,* laboratory technician, Valley Steam Plant, Department of Water and Power, Los Angeles, Calif.

Application and Treatment of Water for Heat-Pump Systems. C. W. Millsom, vice-president, Acme Industries

9:00 a.m. **Louix XVI Room**

Electrical-System Planning I

Chairman: *E. A. Cooper,* chairman, Power Group, Chicago Section, AIEE, and electrical engineer, Harza Engineering Co.

Associate Chairman: *E. B. Eggers,* research engineer, Illinois Institute of Technology

Planning Systems for Long-Range Growth. *H. L. Melvin,* chief consulting engineer, Ebasco Services Inc.

Location of Future Generation—Economic Analysis. *G. P. Wilson,* manager, of power production, Illinois Power Co.

10:30 a.m. **Louis XVI Room**

Electrical-System Planning II

Chairman: *W. A. Lewis,* dean of the Graduate School, Illinois Institute of Technology

Associate Chairman: *E. L. Nicholson,* manager, engineering, General Electric Co.

The Function of Land-Use Surveys in Power Planning. *E. L. Kanouse,* assistant engineer of construction and design, and *J. W. Reinhard,* electrical engineering associate, Department of Water and Power, Los Angeles, Calif.

Possibilities for Greater Regional Co-Ordination of Power Systems in the United States. *F. L. Adams,* chief, Bureau of Power, Federal Power Commission, Washington, D. C.

10:30 a.m. **Crystal Room**

Water Technology III

Chairman: *W. L. Jackson,* vice-chairman, Power Station Subcommittee, Prime Movers Committee, Edison Electric Institute

Associate Chairman: *Seldon Adkins,* director, Technical Service, Boiler Feedwater, National Aluminate Corp.

Conditions Where Sticking of High-Pressure Steam Valves May Occur. *C. L. Mead,* design engineer, General Electric Co.

Blue-Blush Characteristics. *F. G. Straub,* research professor of chemical engineering, University of Illinois

10:30 a.m. **Assembly Room**

Industrial Steam Generators

Chairman: *Ben G. Elliott,* chairman, department of mechanical engineering, University of Wisconsin.

Associate Chairman: *N. L. Markerich,* co-chairman, Power and Fuels Division, Chicago Section, ASME

Air Preheater for Small Power Plants. *W. F. Hammond,* chief engineer, and *C. L. Brown,* technical consultant, Air Preheater Corp.

Standard Steam Generators—Influence of Design Changes on Cost. *D. Cassino,* design engineer, Foster Wheeler Corp.

12:15 p.m. **Bal Tabarin Room**

American Power Conference Luncheon

Sponsored by the Western Society of Engineers.

Chairman: *J. F. Sullivan, Jr.,* president, Western Society of Engineers and manager of construction, Commonwealth Edison Co.

Associate Chairman: *R. G. Owens,* dean of engineering, Illinois Institute of Technology

Speaker: *Farrington Daniels,* chairman, department of chemistry, University of Wisconsin

Subject: *Solar Energy.*

2:00 p.m. **Grand Ballroom**

Progress in Nuclear Technology for Power Generation

Chairman: *D. H. Loughridge,* dean of engineering, Northwestern Technological Institute

Associate Chairman: *A. W. Kramer,* editor, *Power Engineering*

The Nuclear Plant as a Part of Future Power Systems, *B. R. Prentice,* manager, Atomic Power Studies, and *A. G. Mellor,* application engineer, Electric-Utility Engineering, General Electric Co.

Reactor Research and Development. *W. K. Davis,* deputy director, Division of Reactor Development, Atomic Energy Commission, Washington, D. C.

Sodium-Graphite Reactor Power Plants. *Chauncey Starr,* manager, nuclear engineering and manufacturing, North American Aviation, Inc.

Power From Atomic Energy. *J. W. Landis,* sales manager, Atomic Energy Division, The Babcock and Wilcox Co.

2:00 p.m. **Louix XVI Room**

Water Technology IV

Sponsored by Joint Research Committee on Boiler Feedwater Studies

Chairman: *P. B. Place,* 1st vice-chairman, Joint Research Committee on Boiler Feedwater Studies, research department, Combustion Engineering, Inc.

Associate Chairman: *T. J. Hodan,* manager, water-conditioning department, Allis-Chalmers Manufacturing Co.

Filming Amines—Use and Misuse in Power-Plant Water-Steam Cycles. *J. F. Wilkes,* director of research and product development; *W. L. Denman,* directing chemist, Dearborn Chemical Company; and *M. F. Obrecht,* department of chemical engineering and water-treatment consultant, Michigan State College

Experience with Filming Amines for Improving Heat Transfer. *J. G. Weidman,* engineering department, W. H. & L. D. Betz

Junior Forum . . .

Conducted by R. A. Cederberg,[1] Assoc. Mem. ASME

A Liberal Education

By F. Everett Reed,[2] Mem. ASME

We often hear about the importance of engineers studying the humanities in order to give breadth to their education. This is important because such studies give the engineer perspective to see aspects of his work other than the immediate problem at hand; they assist him in developing the ability to express himself; they help him to understand his fellow men and his society; they help him to be a better citizen; they acquaint him with the great thinkers who have provided the foundations of our civilization; and they give him a source of inspiration and recreation which is uplifting when discouraged, soothing when upset, humbling when conceited, and of a type which will develop his character.

Engineering Process of Thought

However, my thesis here is not in the direction of humanities and a liberal education for engineers, but rather that a liberal-arts student needs some understanding of the engineering process of thought in order to have a liberal education. By the engineering process of thought, I mean the practice of breaking down complex problems into more easily comprehensible parts, solving the parts, and from these building up the solution.

Our present world is becoming too beset with complex problems and is getting to have too short a time constant to accept the trial-and-error solution of these problems on the basis of intuition, superstition, and prejudice. We need to break down our problems into parts which we can comprehend. We need to logically decide what are the controlling factors in a problem. We need to think in fundamental terms.

Scientific Method

The engineer has been singularly successful in applying the scientific method to engineering problems. Without prejudice he can say whether it is better economy to build a particular hydroelectric plant or a steam-power plant. This logical unprejudice thought practice has not been so successful as in its application to problems of government, social relations, or religion. This is partly true because social problems are much less tangible. However, we must remember that it was only a short time ago that calculations of the strength and deflection of a beam were similarly intangible.

Although the application of the scientific method is learned through mathematics and science, its biggest field of common application is probably in engineering. Even here the field is limited and engineering is not generally taught as a particular application of a broad general principle. There are steps being made to widen the field of application of the scientific method. One of these is the field of operations research which uses scientific methods to assist in solving some of the complex problems involved in executive decisions. Even where the problems cannot be handled in terms of numbers, the scientific method is still the most effective approach to a solution. Getting as many relevant data as practical, picking the major variables, analyzing the effect of each on the whole problem and, above all, being free from bias, prejudice, and preconceived notions are the basic necessities for any effective thinking process.

We need to strengthen our understanding of the fundamentals of our social behavior. We need to find out what are the variables which determine the stability of our economic system. We need to evaluate the elements on which we base our individual lives. Why am I living? What do I expect to give and to get from the world? How do my standards fit into society? How should I tie my life into the complexity of life around me?

In the feudal era, man could get along reasonably well by following tradition and his intuition. Now we have too much power at our disposal. Our social and economic system responds too rapidly to inflammatory and disturbing functions to permit the luxury of prejudice and fuzzy thinking. The same type of scientific thinking which has led to our material development must be applied to its control. We need more and better thinkers and analysts who have been trained to approach complex problems by first breaking them into understandable parts and then solving them by applying, without prejudice, appropriate fundamentals.

. . . Chairman's Corner[3]

This month I want to briefly discuss the Junior Forum which is conducted under the direction of the National Junior Committee. The Junior Forum is used to describe the activities of the National Junior Committee; to stimulate the younger members of the Society to greater participation in society affairs; report on the Junior Sessions at the various national meetings of the Society; discuss various phases of professional development and industry training methods; and report on some of the activities of the Section Junior Groups. It is intended as a sounding board for the problems and interests of the Associate Members of the Society, particularly the newer members in this group. It cannot be truthfully said that the Forum has accomplished all of these goals. We wonder why more of you do not attend the Annual, Semi-Annual, Spring, and Fall Meetings of the Society when they are held in your part of the country—particularly the National Junior Committee sessions at these meetings. We also wonder why more of you do not prepare papers for presentation at the various Society meetings.

If you have ideas as to how the Society can be of greater assistance to you and/or others, drop us a line through National Headquarters at 29 West 39th Street, New York 18, N. Y. We are not guaranteeing positive results in every case but feel that you will get action in many cases. Keep in mind that, if you wish to get the most from the Society, you have to give a little more now and then.

[1] Westinghouse Electric Corporation, Pittsburgh, Pa.

[2] Arthur D. Little, Inc., Cambridge, Mass. Junior Advisory Mem. ASME.

[3] Chairman of National Junior Committee, Charles T. Miller, Engineering Division, Curtis-Wright Corporation, Wright Aero Division, Wood-Ridge, N. J.

Columbia University Starting Pegram Atomic Laboratory

A nuclear-physics research building to house a new six-million-electron-volt accelerator has been started at Columbia University. The accelerator will be located on the campus.

In making the announcement, Grayson Kirk, president of Columbia, said the $350,000 structure would be known as the George B. Pegram Laboratory.

The Atomic Energy Commission is providing $295,000 toward the cost of the building. The remainder is to come from the university.

Dean George Braxton Pegram, Fellow ASME, is special adviser to the president of the university and in charge of negotiations involving government-aided research at Columbia, He had a major role in development of the nation's atomic-energy program.

Meetings of Other Societies...

March 14–15
Steel Founders' Society of America, annual meeting, Drake Hotel, Chicago, Ill.

March 14–16
Society of Automotive Engineers production meeting and forum, Netherland Plaza Hotel, Cincinnati, Ohio

March 28–29
American Institute of Electrical Engineers, materials-handling conference, Hotel Cleveland, Cleveland, Ohio

March 28–April 1
American Society for Metals and 24 other technical societies, including the ASME Southern California Section, ninth Western Metal Exposition, Pan-Pacific Auditorium, Los Angeles, Calif.; ASM, ninth Western Metal Congress, Ambassador Hotel, Los Angeles, Calif. Society for Nondestructive Testing and American Welding Society, technical sessions to be held as part of Congress. American Foundrymen's Society will meet March 28, also as part of the Congress

March 31–April 1
Symposium on boundary-layer effects in aerodynamics, National Physical Laboratory, Teddington, Middlesex, England

ASME Standards Workshop . . .

Interpretations of 1951 Code for Pressure Piping

From time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinion of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1-1951, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. Case No. 17 is published herewith as interim actions of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

Case No. 17

Inquiry: Is it the intent of Par. 105(*b*) that an allowable stress (*S* values) for materials not included in Table 1 must be assigned before the material may be used?

Reply: It is the opinion of the Committee that the intent of Par. 105(*b*) is to require that a stress value assignment be made before such material may be used. In order to clarify the situation it is being recommended that Par. 105(*b*) and corresponding paragraphs in Sections 2, 3, and 4 of the Code, be revised in accordance with the following wording:

(*b*) Should it be desired to use any materials or methods of manufacture not now covered by this code or which may be developed in the future, it is intended that the manufacturer shall provide details of design and construction which will be as safe as otherwise provided by the rules of the code. Where it is desired to use materials not included in Table 1, written application shall be made to the Committee fully describing the proposed material and the contemplated use, requesting that an allowable stress (*S* value) be assigned. Such materials shall not be used until the stress values have been assigned.

Actions of the ASME Executive Committee

At a Meeting at Headquarters on Jan. 19, 1955

A Meeting of the Executive Committee of the Council was held on Jan. 19, 1955, in the rooms of the Society. David W. R. Morgan, chairman, presided. Also present were: Frank L. Bradley, Thompson Chandler, Albert C. Pasini, and W. F. Thompson of the Executive Commitee; L. N. Rowley, Jr., chairman, Finance Committee; J. L. Kopf, treasurer; E. J. Kates, assistant treasurer; H. C. R. Carlson, R. B. Lea, and Joseph Pope, directors; C. E. Davies, secretary; O. B. Schier, 2nd, assistant secretary; T. A. Marshall, Jr., assistant secretary; and Ernest Hartford, consultant.

Survey-Questionnaire Appropriation

The Executive Committee on Sept. 30, 1952, authorized an appropriation from the Members' Service Reserve for the circularization of the entire membership to ascertain special interests and skills. An appropriation of $6000 was allotted. The Secretary reported that expenditures amounted to $8500, the increase being due to additional reports prepared by the International Business Machines Company. Upon recommendation of the Finance Committee, the Committee voted to increase the original appropriation to $8500.

Board on Public Affairs

It was voted to approve expanding the personnel of the Board on Public Affairs to include the ASME representatives on Engineers Joint Council, and to request the Constitution and By-Laws Committee to submit this to the Council at its June, 1955, meeting for first reading.

Section Awards

In 1954, at the suggestion of the 75th Anniversary Committee, a special Section Award was established to be given "to that member of the Section who has, in the opinion of the Section, done most to further the aims and objectives of ASME." The award consists of the 75th Anniversary Medal and a certificate. Eight sections plan to present this award during February. The Executive Committee approved the following nominations for Section Awards: E. W. Allardt, Canton-Alliance-Massillon; Thompson Chandler, West Virginia; Alexander G. Christie, Baltimore; Mark P. Cleghorn, Central Iowa; Cecil R. Davis, Toronto; Harry R. Kessler, Metropolitan; Justin J. McCarthy, Philadelphia; E. L. Robinson, Schenectady.

Technology-Executives Conference

The President reported a successful Technology Executives Conference which was held in Harmarville, Pa., Jan. 13–14, 1955, at the Gulf Research Laboratories. The Executive Committee voted to express appreciation and thanks to the Gulf Research and Development Company for the courtesies and hospitality extended to those who attended the Conference. (See pages 282–285 of this issue for a report of the meeting.)

Elmer A. Sperry Award

Mrs. Robert B. Lea, daughter of the late Elmer A. Sperry, proposed the establishment of an award in commemoration of the life and achievements of her father to be known as the Elmer A. Sperry Award. The award would be "for the purpose of encouraging progress in the engineering of transportation and be bestowed in recognition of a distinguished engineering contribution which through application, proved in actual service, has advanced the art of transportation whether by land, sea, or air."

The award would be presented by a Board composed of at least two members selected from each of the four engineering societies in which Mr. Sperry was most active: The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, Society of Automotive Engineers, and the Society of Naval Architects and Marine Engineers. The award would consist of a citation, a bound copy of the Biographical Memoir of Elmer A. Sperry, published by the National Academy of Sciences, an honorarium, and a bronze medal. The Executive Committee voted to accept the deed of gift, to establish the Elmer A. Sperry Award, and to undertake the responsibility of administering the award.

Research Contract

The Secretary reported a contract between the Joint ASTM-ASME Committee on Effect of Temperature on the Properties of Metals and the Battelle Memorial Institute. The contract involves research investigations in connection with compilation of high-temperature data for carbon steel, bolting steels, and chromium steels for the Data and Publications Panel Project DP-8 of the Joint ASTM-ASME Committee. The contract became effective as of Jan. 15, 1955, and covers a period of 12 months.

Applied Mechanics Reviews

The Secretary reported that the National Science Foundation had authorized an appropriation of $10,000 for the operation of *Applied Mechanics Reviews*. The Air Research Center will contribute $10,000.

Frequency-Response Book

Arrangements have been made with The Macmillan Company for the publication of a book entitled "Frequency Response Symposium" to be sponsored by the Instruments and Regulators Division. The Executive Committee voted to authorize the publication of such a book in accordance with a contract submitted by The Macmillan Company.

1954 Power Show

A check for $500 was received from the International Exposition Company for an additional payment in connection with the 1954 Power Show. The Committee authorized crediting the sum to the Research Reserve.

1955 Power Show

The following men were approved to serve as ASME representatives on the 1955 Advisory Committee for the Power Show: D. W. R. Morgan, president; A. C. Pasini, G. A.

Hawkins, J. H. Davis, and R. B. Lea, directors; Alex D. Bailey, and J. D. Cunningham, past-presidents; R. B. Smith, chairman, Board on Technology; R. W. Flynn, chairman, Meetings Committee; and C. E. Davies, secretary.

Certificates of Award

A special certificate for sixty-five years of membership in the Society was authorized for the following: W. W. Dashiell, Charles H. Davis, Frank G. Hobart, George E. Hunter, Edward A. Muller, and Ernest N. Wright.

A Certificate of Award was granted to W. A. Carter "for outstanding leadership in the development of Test Codes and the Supplements on Instruments and Apparatus."

The following retiring chairmen of Sections were granted certificates: Ellis P. Hansen, Milwaukee; and Ted C. Sheets, Toledo. A. Warren Colwell, who served as chairman of the Milwaukee Section in 1952–1953, also was granted a certificate.

American Power Conference

The American Power Conference will hold its 17th annual meeting in Chicago, March 30–April 1, 1955. The Society has been invited to participate as one of the co-operating societies. The Executive Committee authorized co-sponsorship in the Conference for 1955 without commitment for future conferences. (Sessions of particular interest to mechanical engineers have been selected from the conference program and appear on pages 289-290 of this issue.)

Literature for Formosa

William G. Christy transmitted a communication from Paul B. Eaton, former member of the Council, now in Formosa on an educational mission, requesting the Society's support in securing publications for engineers in Formosa. It was suggested that publication of the request be made in MECHANICAL ENGINEERING and that members of the Council be asked to co-operate.

Memorial-Lecture Fund

The Society has been asked to contribute to the Charles Le Maistre Memorial Lecture Fund which has been set up by the International Electrotechnical Commission in honor of its late General Secretary. A contribution of $25 was authorized from the Secretary's Emergency Fund.

Peaceful Atomic Development

The President reported that he had received an announcement of the formation of a private or nongovernmental organization to promote the constructive development of atomic energy on an international basis. It is to be known as the Fund for Peaceful Atomic Development, Inc., a nonprofit organization. Walker L. Cisler, president of the Fund, stated that it was believed that the Fund "can play a useful role in mobilizing the human, scientific, and educational resources available in our own as well as other countries for this challenging task." It was hoped the undertaking would "have the good wishes and suggestions of the ASME as this organization goes into operation."

The committee voted to express its agreement with the purpose of the Fund for Peaceful Atomic Development, Inc., and to give moral support to this program.

Appointments

The Committee approved the appointments on committees and joint activities recommended by the Organization Committee at its meeting of Jan. 17, 1955.

The following presidential appointment was noted: H. E. Bumgardner to Michigan State College, 100th Anniversary, Feb. 12, 1955.

Engineering Societies Personnel Service, Inc.

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members, or nonmembers and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Mechanical Engineer, 29; varied experience includes reciprocating engines; diesels; marine engines; electronics; subcontracts; purchasing, planning, and scheduling; patent; administering contracts; personnel; industrial and public relations. Me-181.

Sales Manager, successful sales record resulting from contact with engineering, research, and executive personnel. Sales, administrative, and manufacturing experience in textile industry. Textile-engineering graduate. Me-182.

Assistant or Chief Engineer, development or research; MSME; 20 years' integrated experience covering many mechanical products through light to heavy range. Skilled in technical management and building of personnel; seven years' experience at management levels. Me-183.

Mechanical Engineer, 38; BME; broad experience in instrument and electronics fields; electromechanical design, project supervision, sales, government contracts, management. Desires management or supervisory position, preferably small or medium company. Me-184.

Executive Engineer-Industrial Engineer, 43; BSME; member ASSE; IES; 21 years' varied engineering and industrial experience. Executive staff, research, and advisory agency; consulting engineer on illumination and job analysis; sales engineer, intangibles and products; safety director, 1 aircraft-engine manufacturer, multiplant operation; 2 manufacturer electric-household appliances; 3 air-base construction, overseas. Strong background administration, industrial relations, etc. Will relocate in the United States or overseas. Me-185.

Management Engineer, 42, married; interested in American expansion in Australia, New Zealand area; 20 years' experience in administration, budget procedure, cost and market analysis, supervision plant design, construction, operation, and maintenance; heavy-machinery sales. Desires to remain in Australasian area. Me-186-104-D-San Francisco.

Mechanical Engineer, 45, single; experienced Australian civil, mechanical, electrical engineer; completed master's degree in petroleum; 15 years' supervision heavy construction Australia, England, India, Middle East, Central America, including oilfield plants, pipe lines, pump stations, harbor-terminal installations. Desires responsible foreign position. Me-187.

Mechanical Engineer, qualified to supervise technical engineering staff and mechanics, all crafts. Twenty years' experience in all phases of maintenance of power, heating plants, air conditioning, refrigerating systems, sewage-disposal projects, elevators, and conveyers. Prefers Eastern seaboard. Me-189.

Mechanical Engineer, 36, married; BSME; background in regional sales, service, new-product promotion, field testing, development, technical reports, training schools, instruction manuals on internal-combustion engines; heavy commercial power plant; other experience. Me-190-Chicago.

Mechanical Engineer, 28; BSME; two years' experience co-ordinating expansion of turbine-laboratory facilities, specification and report writing; three years' experience as supervisor drop-forge; one and a half years' experience in manufacture power-plant equipment. Desires domestic or foreign employment. Me-191-Chicago.

Mechanical or Maintenance Engineer, 31, married; five years' design and construction of fluid-processing facilities; one and a half years' supervision of maintenance in chemical plant. Prefers West Coast. Me-192-106-D-San Francisco.

Production Manager or Chief Engineer, 35, married; BSME; 18 years' diversified experience in engineering, production, management, and labor; cost-reduction and profit emphasis. Record of results in metals, heavy process, and drugs. Me-193.

Mechanical Engineer, 43; BSME; V.P.I.; PE; heating, ventilation, air-conditioning, boiler plants, gas plants, control equipment, piping, district steam-heat design experience; seven years' gas and ammonia plant operation. Prefers South. Me-194.

Professional Engineer, 20 years' supervisory experience, planning and executing chemical and textile-plant projects; available for responsible position requiring engineering and business judgment. Me-195.

Mechanical Engineer, 40, married; specialized in diesel engineering; installation, rebuilding, operation, design, survey; broad mechanical and

[1] All men listed hold some form of ASME membership.

administrative background. Knowledge of four languages. Prefers West Coast or mountain states. Me-196-208-D-San Francisco.

Positions Available

Chief Industrial Engineer, 35–45, thorough knowledge and experience in time study, and administration of a standard-hour-wage-incentive plan; at least five years' experience as time-study engineer as well as three years as head of industrial-engineering department; heavy background in methods covering such operations as layout, shearing, rolling, welding, material handling in heavy-plate work. Will head up industrial-engineering activities. Salary open. Central N. Y. State. W-869.

Chief Engineer, mechanical, at least ten years' design and supervisory experience in special and textile-machinery fields including chain-stitch equipment. Southern Germany. F-892.

Sales Manager, mechanical or electrical graduate, 35–45, at least five years' experience selling a national line of equipment to heavy industry, such as machinery. Knowledge of dust problems. Duties will include heading up national sales organization of direct sales and manufacturers' agents, calling on industries, in general, on line of dust collectors. $9000–$10,000, plus incentive. Employer will pay fee. Considerable traveling. Northern N. Y. State. W-908.

Plant Engineer, 33–35, mechanical, about ten years' experience in a chemical plant; some design experience. Experience or knowledge of electrical distribution, boiler operation, and steam distribution; building knowledge, report writing, estimating and maintenance systems. $10,000–$15,000. New England. W-915.

General Manager to assume administrative responsibilities and complete direction of a manufactured gas utility. In addition to previous supervisory experience, must have sales and technical background. Salary commensurate with ability and experience. Submit detailed résumé of background, experience and salary requirements. New England. W-949.

Senior Design Engineer, 35–45, mechanical, at least ten years' internal-combustion engine, air-compressor, or gas-turbine experience, for design and development of rotary compressors. $8000–$10,000. East. W-954.

Chief Engineer for product department, mechanical or electrical graduate, to direct all engineering activities covering design, manufacture, installation and operation, and research activities in electrical and mechanical process-equipment fields. $10,000–$12,000. East Coast. W-964.

Plant Manager, 40–50, good background, to head up production, production control, purchasing, industrial engineering, quality control, materials handling, and traffic in a division of 1000 employees. Should have experience in sheet-metal fabrication on such products as furnaces and aircraft accessories, with both high production and job-shop operation. Salary open. Midwest. W-971.

Development Engineer, electrical, at least five years' developing and designing household appliances and related mechanical devices; capable of carrying project through from initial concept, sketches, models, to finished design and layout. Will be assigned to develop new products and modify present product line. $7500–$8000. New England. W-988.

Industrial Engineer, at least three years' experience covering time study, rates, plant layout, production analysis, and materials handling in chemical-process industry. $6000. Conn. W-996.

Assistant Engineer, mechanical, ten to 15 years' experience reviewing designs and estimates on all mechanical phases in a large mining operation, as power-plant shovels, truck, or handling railroad equipment and shops, etc. Knowledge of Spanish desirable. $10,500, plus or minus; in addition to living allowance of $260 a month. South America. F-1003.

Instructor, BS degree in mechanical engineering or architecture; some experience in drawing instruction preferred. Will teach freshmen engineering drawing and descriptive geometry. Study for MS degree permitted and encouraged. $3840 for ten months. New England. W-1011.

Engineers. (*a*) Director of engineering, 40–50, mechanical, at least 20 years' experience; with ability and know-how in machine design, to be top executive reporting to president of company. Must have proved record of administrative ability. Salary open, plus bonus. (*b*) Project engineer, 35–50, mechanical, at least 15 years' experience. Will work for a company primarily engaged in machine design such as steel-forming equipment, solder-type mills, forming mills, pipe mills, etc. Applicant must know general construction of machinery. Salary open, plus bonus. Ohio. W-1012.

Engineers. (*a*) Product engineer, 35–45, mechanical or electrical graduate, capable of running own department, including laboratory testing and general engineering. Should have experience in instrument field, i.e., pressure and liquid gages, indicators, thermometer, etc. $7500–$9500. (*b*) Manufacturing engineer, 35–45, to head up all machinery programming, manufacturing processes. $7000–$9000. N. Y. State. W-1015.

Assistant Plant Engineer, about 40, industrial, chemical, mechanical, or civil graduate, four or more years' experience in plant engineering, food, pharmaceutical, or chemical-processing plants. Will be staff consultant on design and layout of plants, mechanical equipment, machinery, and parts for a manufacturer of liquid foods. $6000–$8000. Considerable traveling. Headquarters, N. Y. State. W-1028.

Engineers. (*a*) Factory manager, under 35, mechanical or industrial-engineering graduate, at least five years' experience covering precision production, production control, quality control, costs, etc., in aircraft-electromechanical field. $10,000–$15,000. Must be citizen. (*b*) Design engineer, under 35, mechanical or electrical, at least five years' experience covering design of aircraft-control accessories to design electrohydraulic servo mechanisms. $8000–$12,000. (*c*) Chief production engineer, mechanical or electrical, at least ten years' aircraft-accessories experience, to supervise design for production and tool engineering. $12,000–$15,000. N. Y. State. W-1036.

Administrative Supervisor, mechanical, industrial design and product-engineering experience to take charge of drafting schedules, customer liaison, and product application for industrial consultant. $6000–$7000, plus bonus. New York, N. Y. W-1041.

Sales Engineer, mechanical, knowledge and sales experience in the oil-hydraulic field, medium to heavy hp range, up to 320 hp. $6000–$7200, and an expense account, plus other benefits. Headquarters, N. Y. or N. J. W-1049.

Sales Engineer, under 30, mechanical, background in automatic machine design. This experience is necessary. Will sell machine components, indexing mechanisms, etc. $7000, plus incentive. Territory, Eastern seaboard. W-1058.

Engineers. (*a*) Vice-president to head up engineering and sales of company engaged in the manufacture and sale of gages and gage devices to control automatic machine tools, particularly grinding tools. Salary open. (*b*) Sales engineer, young, for company manufacturing gages and gage devices to control automatic machine tools, particularly grinding tools. Some experience in this field desirable. Salary open. New York, N. Y. W-1060.

Assistant to President, administrative and office-management experience in heating, ventilating, plumbing, and air-conditioning fields for staff duties with consulting-engineering firm. $10,000–$12,000. New York, N. Y. W-1061.

Water-Utility Executive, civil or mechanical, professional engineer's license. Experienced in hydraulics, pumping, and gravity, with large-sized pipes up to 60 in.; surveying, knowledge of right-of-way locations; standard procedure of public-utility accounting. Salary open. New England. W-1063.

Instructor or Assistant Professor, to teach industrial engineering. Opportunity to work for advanced degrees. Instructor, $3420–$3960, academic term; assistant professors, $3980–$4520, academic term; summer-school teaching available. South. W-1068.

Manager for Standards Department; experience in time study, methods, and costs; must know machine-tool operations; a knowledge of M.T.M. methods. Man must have experience in a type of industry dealing with "one shot" as well as straight-line production. Salary open. New England. W-1072.

Industrial Atomic-Power Engineer, design studies and evaluation of over-all hydrodynamics systems, response characteristics, interaction of fluid systems, thermal and mechanical analysis etc., for nuclear-electrical power plants. BS or MS in mechanical or electrical engineering; experience in fundamental hydrodynamics desirable. Western Pa. W-1086.

Refrigeration-Control Development Engineer, 30–55, at least five years' experience in designing or developing refrigeration controls or expansion valves on small compressors or air-conditioning equipment. Duties include project work, developing, and designing controls, follow through on samples and tests of pilot models. Up to $10,000. Employer will negotiate fee. Travel 20 per cent of time. Ill. C-2516.

Engine Designer, up to 55, at least three years' experience in designing or developing heavy internal-combustion engines, for manufacturer of engines. $7200. Iowa. C-2518.

Chief Staff Engineer, mechanical, up to 40, at least five years' experience in supervisory plant-maintenance work in multiplant organization, preferably heavy chemical, steel, or mining company. Must have knowledge of heavy-process equipment. Will serve as staff consultant on all mechanical and plant engineering problems and equipment for a multiplant in heavy chemical and processing field. $10,000–$12,000. Employer will pay fee. Considerable traveling. Ill. C-2531(*a*).

Industrial Engineer, industrial or mechanical graduate, up to 32, at least two years' experience; knowledge of steel-mill operations, to learn steel-mill management by taking time studies, developing data, incentives, plant layout, etc. $4500–$6000. Ill. C-2555(*a*).

Process-Methods Engineer, mechanical or electrical, up to 45, at least five years' experience in methods and process work and assembling housed electronic equipment; knowledge of plastics, wood, and both ferrous and nonferrous fabrication. Duties include processing electronic equipment through manufacturing; some parts made and some assembled using machine-shop, sheet-metal shop, and bench assembly. Must be able to take blueprint and decide how to proceed from there. $7000–$12,000. Mich. C-2558.

Chief Engineer, about 40, at least five years' experience in metal fabrication, to play layout, mechanical-facilities design, co-ordination of engineering departments, estimate cost of manufacturing, and general trouble shooter for vice-president of company manufacturing and fabricating metal products such as shells. $8000–$12,000. Employer will pay fee. Ill. C-2566.

Design Engineer, mechanical, at least two years' experience in product design and development; knowledge of laundry equipment desired. Will start with and spend considerable time on board becoming familiar with company's product, which is commercial-laundry equipment. $6000–$7000. Ill. C-2568.

Steel-Mill Process Consultants, at least six years' experience in steel-mill processing work. Two men with good processing background in seamless-tubing operations. One of these should have metallurgical training; five men who are well versed in hot-rolled strip-mill operations. All will act as technical advisors on processing. Six to eight months' foreign assignments, for a consulting-engineering-management concern. $12,000, and per diem expense. Employer will pay fee. Yugoslavia. C-2571.

Assistant Range Engineer, mechanical or electrical graduate, 25–35, at least five years' experience in designing and developing electrical devices with mechanical motion; knowledge of appliance controls helpful. Will do creative engineering analyses of electrical-mechanical devices for controlling major appliances and particularly ranges. $5000–$8000. Ill. C-2578(*a*).

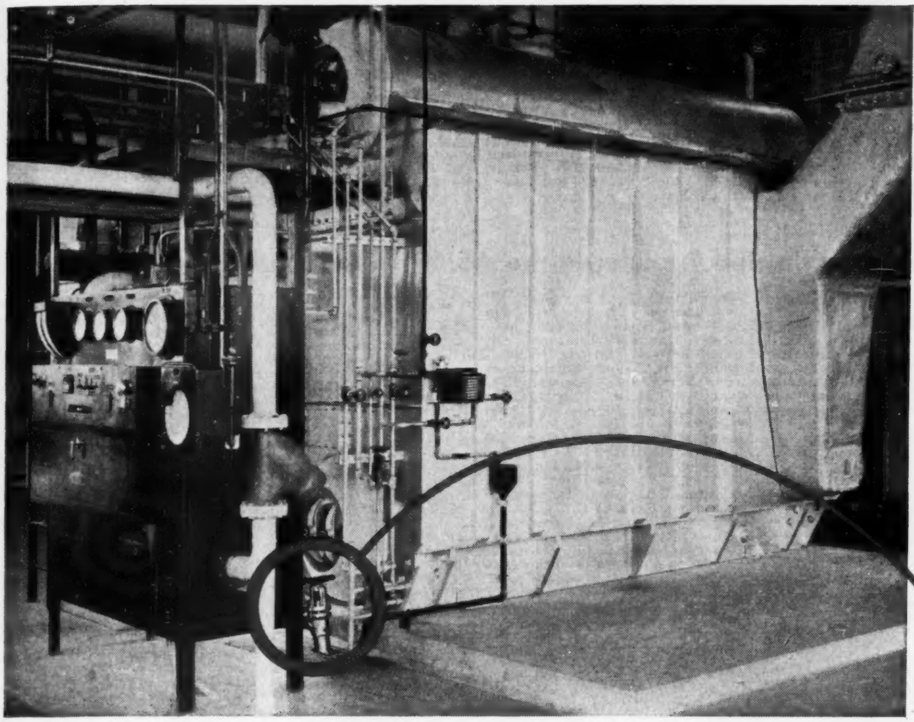
Staff Plant Engineer, mechanical, to 50, at least five years' experience in multiple plant-preventative maintenance engineering and cost surveys; knowledge of bulk and building-material manufacturing. Will be staff advisor to vice-president in charge of manufacturing. Up to $12,000. Considerable traveling. Hdqrs., Ill. C-2591.

Manufacturing Executive, mechanical, electrical, or chemical-engineering graduate, a minimum of 15 years' in product design, methods and process development, and all other basic manufacturing function; experience in light manufacturing industry, for developing the tooling and manufacturing product specification for new products in automatic-control devices. $12,000–$18,000. South Wis. C-2594.

Engineers. (*a*) General manager, 40–50, at least five years' experience in over-all administrative and sales duties of a stamping plant producing on mass-volume low-cost basis as would be required in automotive industry. Duties will include managing a plant and business engaged in manufacturing of gears and stampings; some job-shop runs as well as mass production. $10,000–$12,000. Company might pay fee. (*b*) Chief tool engineer, 40–50, at least five years' experience as chief inspector in tool, gear, or stamping shop, working to close tolerances, to supervise design, processing, and manufacturing tools for close tolerances stamping and gear cutting. $7200–$9000. Ill. C-2602.

General Manager, 45–55, at least five years'

(*ASME News continued on page 296*)



COMBUSTION ENGINEERING ADOPTS YARWAY SEATLESS BLOW-OFF VALVES FOR PACKAGE BOILERS

Combustion Engineering, Inc. on this package boiler installation at the Orangeburg Pipe Plant in California, again includes Yarway Seatless Blow-Off Valves as part of the "package."

It's a popular idea—and growing fast. All *good* package-type boiler installations are *better* when equipped with Yarway Seatless Blow-Off Valves.

More and more boilermakers are standardizing on Yarways, and more and more boiler users are expecting the advantages of Yarway Blow-Off Valves on their package units.

Get the full story on why more than 15,000 boiler plants use Yarway Blow-Off Valves, some for 30 to 40 years.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

Yarway Type "B" Seatless Tandem Blow-Off Valve. Note balanced sliding plunger design with no seat to score, wear, clog or leak. Pressures to 400 psi.

YARWAY BLOW-OFF VALVES

experience in heavy management work, and ability to make decisions in steel-plate fabrication and wooden-boat building or repairing. Will manage the engineering, building, and repairing of marine equipment for an engineer and builder of boats. $10,000–$12,000. Employer will pay fee. Ill. C-2610.

Production Tooling and Methods Engineer, 35–45, at least five years' experience in manufacturing or fabrication of metal parts on mass-production basis; knowledge of flat-parts tooling for punch presses and precision machining. $10,000–$15,000. Calif. C-2631(*b*).

Senior Project Engineer, BS(ME), 30–50, at least five years' experience in research development of small electrical and mechanical components, including supervisory and administrative duties, plus program planning and report writing. $6900–$9600. Employer will pay fee. Ill. C-2641(*a*).

Miller, Ward M., Newton, Iowa
Nelsen, Robert, Cincinnati, Ohio
Olsen, Gustav E., Arverne, N. Y.
Pfeffer, James F., Jr., Wilmington, Del.
Roe, Kenneth A., New York ,N. Y.
Rylander, Henry G., Austin, Texas
Siegerist, Walter L., Affton, Mo.
Wiley, Russell C., Cranston, R. I.

Transfers from Student Member to Associate Member....................................60

Candidates for Membership and Transfer in the ASME

The application of each of the candidates listed below is to be voted on after March 25, 1955, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

Key to Abbreviation

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

New Applications

For Member, Associate Member, or Affiliate

Albright, Robert S., Atlanta, Ga.
Allman, George J., Charleston, W. Va.
Ambrook, Robert F., Lansing, Mich.
Anderson, Thomas B. H., Jr., Charleston, W. Va.
Angus, A. Stuart, Jr., Hicksville, N. Y.
Anthony, Andrew J., Wellsville, N. Y.
Baase, Frederick C., Pittsburgh, Pa.
Balje, Otto E., Hollywood, Calif.
Bardalaye, Amulya C., Assam, India
Barkle, John E., Jr., E. Pittsburgh, Pa.
Barlow, Arthur H. F., New York, N. Y.
Bartlett, Floyd M., Tulsa, Okla.
Barton, Serge P., Ridley Park, Pa.
Bennett, Warren G., Indianapolis, Ind.
Bhattacharyya, Asoka K., New York, N. Y.
Billingslea, Clifford M., Jr., Alliance, Ohio
Blackwood, David E., Washington, D. C.
Blaisdell, Irene L., Los Angeles, Calif.
Bogan, C. Warren, Washington, D. C.
Booth, Sylvester F., Elgin, Ill.
Borkenhagen, Wallace H., Los Alamos, N. Mex.
Brees, Dale W., Kansas City, Mo.
Bressette, Delbert M., St. Albans, Vt.
Brisch, Walter F., China Lake, Calif.
Bronson, John C., Los Alamos, N. Mex.
Brown, Arthur F. C., Washington, D. C.
Brown, James S., Cookeville, Tenn.
Busse, Marvin H., Sheboygan, Wis.
Carney, Bernard R., Niagara Falls, N. Y.
Chase, Jim C., Tulsa, Okla.
Chase, Leon, Massapequa, L. I., N. Y.
Chumick, Ivan, Royal Oak, Mich.
Clifford, Joseph N., Boston, Mass.
Clover, Dean H., Burlington, Iowa
Cooke, Charles M., Pittsburgh, Pa.
Copeland, Eugene H., Albuquerque, N. Mex.
Cossaboon, Robert E., Wellsville, N. Y.
Defferding, Leo J., Schenectady, N. Y.
DeRossi, Guido, Barranco, Lima, Peru
DesMaisons, R. Paul, Dorchester, Mass.
Dralle, Henry E., Maplewood, N. J.
Eisner, Gerald, Mount Vernon, N. Y.
Ellison, William, Flushing, N. Y.
Farnsworth, Harold V., Boston, Mass.
Faulds, George R., Racine, Wis.
Fertig, Arthur A., Westfield, N. J.
Fisher, Robert E., Birmingham, Ala.
Forster, James A., Schenectady, N. Y.
Fowler, Frank E., St. Louis, Mo.
Gosselin, Albert E., Los Angeles, Calif.
Groetzinger, William H., 3rd, Huntsville, Ala.
Hacker, Albert L., Manila, Philippines
Hafner, Eugene R., Indianapolis, Ind.
Hager, Richard W., Mobile, Ala.
Harder, Robert C., Sheboygan, Wis.
Harrison, Percy S., Newport News, Va.
Hay, Arthur L., Jr., Savannah, Ga.
Herwick, John S., Cleveland, Ohio
Herzog, Bertram, Cleveland, Ohio
Hittner, Herbert H., Philadelphia, Pa.
Hoffman, Charles M. E., Baltimore, Md.
Holik, William V., Jr., El Paso, Texas
Johnson, Herbert O., Brantford, Ont., Can.
Junge, Richard M., Schenectady, N. Y.
Kalk, Wilbert A., Cassadaga, N. Y.
Kennedy, Robert A., Richland, Wash.
King, Irwin, Elmhurst, N. Y.
Kjemtrup, Jens E. F., Charleston, W. Va.
Klion, Daniel E., Yonkers, N. Y.
Kramer, Lloyd B., Pittsburgh, Pa.
Kris, Edward H., Newark, Del.
Lalchandani, Menghraj W., Baroda, India
Laster, Walter R., Brookfield, Ill.
Levy, Martin J., Bridgeport, Conn.
Libby, Saul H., Los Angeles, Calif.
Lindsay, David W., Cincinnati, Ohio
Lula, Remus A., Natrona Heights, Pa.
Lynch, Paul J., Fort Worth, Texas
Lyons, William J., Charlotte, N. C.
Mandiola, Luis R., Havana, Cuba
Mansell, David W., Garden City, L. I., N. Y.
Markeloff, George, New York, N. Y.
Marks, Robert H., Brooklyn, N. Y.
Martin, Matthew T., New York, N. Y.
Mashburn, William H., Marietta, Ga.
Matsuno, Takeichi, Hitachi, Japan
Maynard, Charles J., Jackson, Mich.
McDonald, Patrick H., Jr., Raleigh, N. C.
McKoy, James B., Jr., Pensacola, Fla.
McLean, Reuben F., Ottawa, Ont., Can.
Michalski, Edward M., Chattanooga, Tenn.
Middleton, Arthur G., Bryn Mawr, Pa.
Miller, Calvin A., Springfield, Ill.
Moring, Walter G., Jr., Toledo, Ohio
Mumper, Henry D., New Milford, N. J.
Newton, Howard L., West Allis, Wis.
Northup, Maynard S., Roselle Park, N. J.
O'Brien, Richard F., Philadelphia, Pa.
Oliver, Charles F., Jr., Pensacola, Fla.
Osola, Vaino J., Sunderland, Durham, England
Pardoe, William S., Merion Station, Pa.
Parsegian, V. Lawrence, Troy, N. Y.
Peterson, John M., Akron, Ohio
Pohlman, John F., Rock Island, Ill.
Poulson, John S., Salt Lake City, Utah
Prohazka, George J., Cranford, N. J.
Puffer, Daniel W., Lynn, Mass.
Querry, Albert S., Ardmore, Pa.
Rahochik, Andrew, Clifton, N. J.
Retzinger, David W., Racine, Wis.
Roberts, John S., Charleston, W. Va.
Rosser, John C., Jr., Godwin, N. C.
Rothbart, Harold A., Teaneck, N. J.
Schorr, Robert A., Mobile, Ala.
Schwarz, Carlos T., Guayaquil, Ecuador
Seck, Charles F., Corning, N. Y.
Selbee, Arthur, Battle Creek, Mich.
Shaw, Horton R., Woodside, L. I., N. Y.
Silver, Alfred H., Cincinnati, Ohio
Smith, Otis B., Mobile, Ala.
Smyth, Lovick P., Chester, Va.
Speer, Ivan E., Phoenix, Ariz.
Steinhauser, Anton L., New York, N. Y.
Steinmetz, Henry G., Jr., Mamaroneck, N. Y.
Stephens, Robert V., Seattle, Wash.
Stephenson, Eben A., Chattanooga, Tenn.
Stephenson, Mark E., Jr., Waltham, Mass.
Strub, Joseph W., Wilmington, Del.
Tenorio, Carlos A., Buenos Aires, Argentine
Thomas, Frank A., Jr., Spring Hill, Ala.
Truebig, Raymond F., Glen Oaks, Queens, N. Y.
Walker, Morton T., Fort Worth, Texas
Warner, Robert K., Silver Spring, Md.
Weikman, Donald, Houston, Texas
Wetzel, Raymond E., Indianapolis, Ind.
Wilson, Joseph A, Amarillo, Texas
Winther, Kaj I., Joliet, Ill.
Wistrand, Hans A., Akarp, Sweden
Womble, Thurman D., Jr., Paducah, Ky.
Wright, Donald H., Somerville, N. J.
Ziefle, Robert G., St. Albans, W. Va.
Zisek, Emil J., New York, N. Y.
Zografov, Theodore S., Hamden, Conn.
Zwerner, Gene A., Washington, D. C.

Change in Grading

Transfers to Member or Affiliate

Batchelder, Lew A., Durham, N. H.
Beltz, Fred W., Jr., Yardley, Pa.
Bienstock, George J., Larchmont, N. Y.
Bulmer, Charlton A., Wilson, N. Y.
Clothier, Robert F., Auburn, Ala.
Crowser, Kenneth E., Huntington Park, Calif.
Donahue, James E., Swarthmore, Pa.
Dyer, Richard F., Kingsport, Tenn.
Ferrari, Raymond E., Staunton, Va.
Fisher, Richard H., Glen Rock, N. J.
Gates, James R., Joliet, Ill.
Graf, Frank E., Birmingham, Ala.
Hebrank, William H., Severna Park, Md.
Hendren, Eugene E., Los Angeles, Calif.
Holz, Charles P., Charleston, W. Va.
Honold, Robert P., Sheboygan, Wis.
Jones, Clarence R., Augusta. Ga.

Obituaries . . .

Amabile Emile Aletti (1909–1954), senior project engineer, Engineering Division, Catalytic Construction Co., Philadelphia, Pa., was killed in an airplane crash, Oct. 26, 1954. Born, Philadelphia, Pa., Feb. 18, 1909. Parents, Louis and Margerite (Damay) Aletti. Education, BS(ME), Drexel Institute, 1932; electronics course, University of Pennsylvania. Married Ann Socinelli, 1942. Assoc. Mem. ASME, 1946. Survived by wife and three children, Vincent, Ann, Adele.

Maxwell Alpern (1884–1954), retired mechanical engineer of Vineyard Haven, Mass., died Dec. 9, 1954. Born, Alpena, Mich., June 25, 1884. Education, BS, University of Michigan, 1906. He held several patents on stoker designs. Mem. ASME, 1916. Survived by wife.

Duncan William Fraser (1875–1954), former president and chairman of the board of American Locomotive Co., New York, N. Y., died Dec. 20, 1954. His 56-year career with Alco spanned a period which started when the company was building wood-burning locomotives and ended after the dieselization of U. S. railroads had been nearly completed. Born, Churchville, Pictou County, Nova Scotia, June 2, 1875. Parents, Simon and Harriet (Cameron) Fraser. Education, high-school graduate. Married Edna Hubley, 1932. Mem. ASME, 1946. Survived by wife; daughter, Mrs. James B. Thorpe, Chicago, Ill.; and sister, Isabelle Fraser, Providence, R. I.

Ernest Albert Garrett (1874–1954), former chairman, Jacobs, Barringer & Garrett, Ltd., consulting engineers and naval architects, London, England, died Nov. 27, 1954. Born, Clapton, North London, England, June 15, 1874. Education, St. Johns-at-Hackney Grammar School, London. Married Ruth Margaret Tiddeman, 1903; son, Edmund Carlton. Mem. ASME, 1907. He was also a member of several other technical societies. At the outbreak of war in 1914 he joined the RNVR and in 1916 was appointed to the Ministry of Munitions as chief inspectior for Railway Material Branch. In 1917 he went to the United States as representative of the Ministry of Shipping, and was supervisor of shipbuilding at Philadelphia, Pa., for vessels building to British Government account, being responsible for both hull and engine departments. In 1919 he was appointed assistant to Lord Inchcape to supervise the taking over of enemy vessels by the British Government and their sale to private owners. He was awarded the OBE in 1921. He was an authority on the design and maintenance of oil tankers and oil-storage installations. He held patents on the "Universal" system of piling, the first successful interlocking steel-sheet piling, and on a form of thread protector for use on oil-well casing. He invented, among several other devices, the hydraulic operated land torpedo. With his brother, Herbert Garrett he was the patentee of the Garratt articulated locomotive.

Charles Elliott Gillett (1888–1954), chief inspector, Norton Co., Worcester, Mass., died Dec. 14, 1954. Born Buckland, Mass., March 27, 1888. Parents, Elliott F. and Luana R. (Newell) Gillett. Education, BS, Worcester Polytechnic Institute, 1911. Married Marion A. Jefts, 1913; son, Newell E. Jun. ASME, 1913; Mem. ASME, 1921.

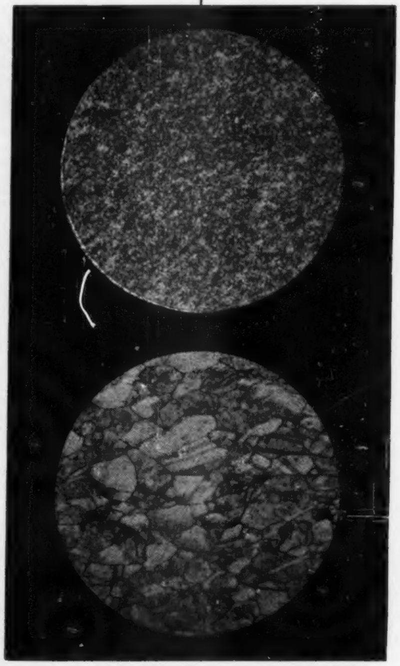
William Osgood Hildreth (1865–1954), one of the country's foremost authorities on post-office conveyer systems, died Dec. 9, 1954, in Syracuse, N. Y. He was associated with the Lamson Corp. from 1903 until his retirement in 1950. Born, Gardiner, Me., Nov. 15, 1865. Parents, Thadeus and Ann Maria (Sevey) Hildreth. Education, BS, Massachusetts Institute of Technology, 1887. Married Mary Elizabeth Hildreth, 1894. Jun. ASME, 1888; Mem. ASME, 1930. In 1953 Mr. Hildreth received a citation marking his 65-year membership in the Society. Survived by a son, Col. Edward E. Hildreth; and a grandson, Cadet Edward E. Hildreth, Jr., of the U. S. Military Academy at West Point, N. Y.

(*ASME News continued on page 298*)

DURAFLEX . . .

a NEW fine-grain phosphor bronze with 30% GREATER ENDURANCE LIMIT

FINE-GRAIN STRUCTURE IS THE MAIN REASON . . .



Micrographs (75x magnification) tell the inside story. Top, note the fine-grain structure of DURAFLEX. Compare it with the grain structure of ordinary phosphor bronze, bottom.

DURAFLEX* is a new, fine-grain phosphor bronze developed and sold only by Anaconda. Comparative fatigue tests show that the endurance limit of DURAFLEX is approximately 30% higher than for ordinary phosphor bronzes. In surface appearance, surface smoothness and resistance to corrosion, it is equal to, or better than, other phosphor bronzes. Further, its formability is increased with no sacrifice in yield strength. DURAFLEX is a *premium* phosphor bronze in every way except cost; there's *no increase in price.*

If you're now using a hard-temper phosphor bronze, chances are that you can do the same forming in extra-hard temper DURAFLEX. If you're looking for longer life in the parts you form, we'll be glad to send you a free sample of DURAFLEX. Try it, test it, and you will agree that it's superior.

5576 *Trade-Mark

DURAFLEX fine-grain phosphor bronze

an ANACONDA® product

MADE BY THE AMERICAN BRASS COMPANY

Try a FREE SAMPLE of

DURAFLEX

Sheet . . . up to 0.062" thick

Wire . . . up to 3/16" diameter (approx.)

FREE SAMPLE

The American Brass Company, Waterbury 20, Connecticut
(In Canada: Anaconda American Brass Ltd., New Toronto, Ontario)

Yes, we'd like to try DURAFLEX. Please send us a free sample of

sheet in ______________ temper, ______________ thick,

wire in ______________ temper, ______________ diameter.

☐ We'd like to talk to one of your metallurgists about DURAFLEX.

NAME..

COMPANY..

STREET..

CITY..........................ZONE....STATE............

Joseph Daniel Kreis (1897–1954), consulting engineer, Cleveland, Ohio, died Nov. 30, 1954. Born, Slobodsia-Komaresty, Bukovina, Austria, March 13, 1897. Education, attended private and public schools until 1910; Real Gimnazium (scholarship), 1914. Naturalized U. S. citizen. Mem. ASME, 1949. He held patents on a rotary punching device, yarn-printing machine, distillation system, and several others. Author of many technical papers presented before various societies.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting this information is printed on this page. Please use it to keep the master file up to date.

ASME Master-File Information

(Not for use of student members)

Please print **Check mailing address**

Name..
Last First Middle

Home address.. ☐
Street City Zone State

Name of employer..

Address of employer... ☐
Street City Zone State

Product or service of company...

Title of position held..

Nature of work done...

I am a subscriber to (please check)

Publication	*Address changes effective when received prior to:*
☐ Mechanical Engineering	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Please register me in three Professional Divisions as checked:

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ V—Gas Turbine Power
☐ D—Materials Handling	☐ M—Production Engineering	☐ W—Wood Industries
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ Y—Rubber and Plastics
☐ F—Fuels	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ G—Safety	☐ Q—Nuclear Engineering	
☐ H—Hydraulics	☐ R—Railroad	

Peder Lobben (1858–1954), retired head of Peder Lobben Technical Correspondence School, Oslo, Norway, which he started in 1916, died Oct. 19, 1954. Born, Modum, Norway, May 10, 1858. Education, common school and technical school in Norway; continued studies in the U. S.; and supplemented studies with various ICS courses. A prolific author his "Machinists' and Draftsmen's Handbook" was published by D. Van Nostrand & Co., New York, N. Y. Several other of his textbooks were published by Aschehoug & Co., Oslo. Mem. ASME, 1895. On May 6, 1946 he received the 50-year membership pin from the Society. Survived by a daughter, Anna.

Curtis Clark Myers (1879–1954), resident director, Daniel Guggenheim Airship Institute, Akron, Ohio, from 1943 to 1949, died Dec. 3, 1954, in Hudson, Ohio. Born, Livonia, N. Y., July 9, 1879. Education, ME, Cornell University, 1903; MME, 1905. While at Cornell he studied under Prof. R. H. Thurston, first president of ASME, and at one time worked for him as a student assistant. Jun. ASME, 1905; Mem. ASME, 1920. Early in World War II he was assistant manager, War Production Board in Syracuse, N. Y., and later was special research engineer in aluminum and magnesium for WPB in Washington, D. C. Survived by wife, Florence.

Frederick Conrad Schoening (1885–1954), ordnance engineer, Bureau of Ordnance, Navy Department, Washington, D. C., died Sept. 8, 1954. Born, Riga, Latvia (Russia), Dec. 9, 1885. Parents, John and Lihbe (Grunert) Schoening. Education, attended Valparaiso (Ind.) University, 1910–1912; BS, Columbia University, 1918; postgraduate work at Columbia, 1921–1922; Massachusetts Institute of Technology, summer of 1921. Naturalized U. S. citizen, New York, N. Y., March 7, 1913. Married Elizabeth Kruhmin, 1917. He held a patent on a powder dispenser. Author of technical papers published in trade journals. Jun. ASME, 1920; Assoc-Mem. ASME, 1923; Mem. ASME, 1935.

Ervin Russell Spencer (1896–1954), superintendent, electric and water plant, City of Grove City, Pa., died Nov. 12, 1954. Born, Allen's Grove, Wis., Dec. 20, 1896. Parents, Charles C. and Emma L. Spencer. Education, BS, State College of Washington, 1926; ME, 1945. Married Elida E. Mangum, 1919; children, Geraldine L., Charles Loren. Author of several papers on petroleum presented before professional and technical societies. Mem. ASME, 1948. Served the Society in the Oil and Gas Power Division activities.

Russell Wellesley Stovel (1877–1954), retired electrical engineer, died Dec. 21, 1954, at his home in Upper Montclair, N. J. Born, Toronto, Ont., Can., Feb. 22, 1877. Parents, Samuel and Jasamina (Callaway) Stovel. Education, BS, McGill University, 1897; MS, 1901. Naturalized U. S. citizen, Essex County, N. J., 1914. Married Helen Grant Eassau, 1901 (deceased); children, Helen M. and Russell W., Jr. Married 2nd, Adelaide Soper, 1936. Jun. ASME, 1902; Mem. ASME, 1907. Survived by wife; son, Russell W., Jr., and daughter, Mrs. Lawrence C. Stearns.

Kurt Toensfeldt (1883–1954), consultant, patent department, Combustion Engineering, Inc., New York, N. Y., died Dec. 7, 1954. Born, St. Louis, Mo., Jan. 10, 1883. Parents, John and Elise (Jansen) Tolensfeldt. Education, BS(ME), Washington University, 1904. Married Margaret E. Barnes, 1915; daughter, Peggy. Author of articles and reviews for *Combustion*. He held six U. S. Patents. Mem. ASME, 1918.

George Alphonsus Weschler (1881–1954), consulting engineer on such projects as the air conditioning of the House and Senate Office Buildings and the restoration of Colonial Williamsburg, died Dec. 27, 1954, at his home in Kenwood, Md. Born, Prince Georges County, Md., May 28, 1881. Education, BS, Purdue University, 1910; ME, 1913. Mem. ASME, 1942. He organized the mechanical-engineering department at the Catholic University in 1910 and taught there for about 25 years. In 1946, as a result of his survey, Congress appropriated $16 million for the modernization program for the Capitol power plant. Survived by wife, Theresa Krogman Weschler; two sisters, Agnes W. and Katherine J., Washington, D. C.; and three brothers, Charles H., Martinsburg, W. Va.; Maurice E., Chevy Chase, Md.; Andrew A., Washington, D. C.